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Expedition Log

Nathan Clark | Day 8

Red Cone Creek and Montgomery Reef



A very early start today as we set of at 0700 to enjoy the sunrise colour palette at Raft Point. The light was incredible, and many photos were taken. After breakfast, we were back out in the Xplorer for a wildlife cruise through Red Cone Creek on a flowing tide. Bird watchers thrilled at the rainbow honeyeaters and we saw mudbanks full of bright red fiddler crabs and a rare giant mudskipper. We then steamed to meet the tides at Montgomery Reef. Aboard the Xplorer and zodiacs, we sat amazed as the reef emerged from the ocean.



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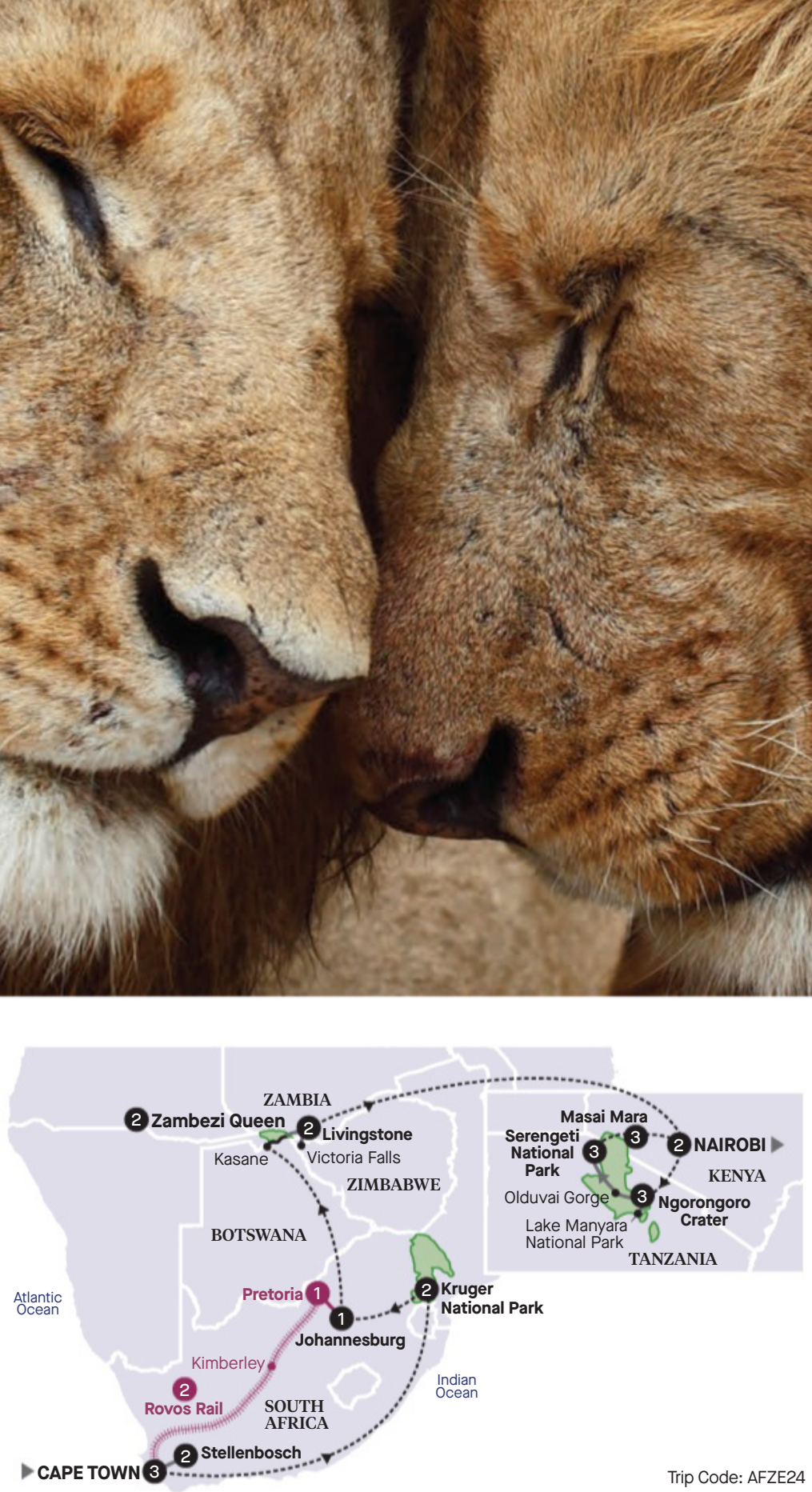
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Your Society

Find out where your donations are going in 2019 and get the latest news. **p28**

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PHOTO CREDIT: DREW HOPPER



Launching *Limiting Factor*, which took Victor Vescovo to the deepest point in the Southern Ocean. See page 96.

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PHOTO CREDITS, CLOCKWISE FROM TOP: RICHARD VARCOE; THOMAS WIELECKI; AARON SMITH; ANDREW GREGORY

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Australian GEOGRAPHIC

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australiangeographic.com.au/issue152

DONATE: Save the GOULDIAN FINCH (p29).

SEE: More photos of the Gondwana Rainforests of Australia (p50).

WIN: A Nature Photographer of the Year pack, valued at $64.90 (p25).

Members of Aboriginal communities are warned that this edition of Australian Geographic may contain images and names of deceased individuals.



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See page **48** for more details

On the cover



The elusive nature of this enigmatic rainforest bird has made it difficult to accurately assess the species' population size. While most of the country's cassowaries (*Casuarius casuarius*) live in the Wet Tropics region of Queensland, there are several smaller populations in isolated rainforest pockets further north. See page 36 for more. Photographer: Dr Ruchira Somaweera.

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Not good enough



WHEN WE hear the term deforestation, it is often accompanied by footage of dense tracts of Amazonian rainforests being illegally bulldozed or aerial images of vast palm oil plantations on once thickly forested equatorial mountain slopes that springs to mind.

In Australia, it might suit us to believe our highly prized native forests are somehow safe from acts of environmental vandalism, but we would be wrong. In this issue we present a special report from Science and Environment Editor Karen McGhee on Australia's alarming rate of native vegetation destruction. It's a record that sees Australia regarded internationally as one of the hotspots of deforestation along with the Amazon, Borneo and the Congo. Landscape-scale tree clearing is a legacy of our colonial agricultural past and a price we paid to build a nation, but it's one we can no longer afford.

The dual economic and environmental benefits of sustainable agriculture that includes the retention and rehabilitation of native vegetation is widely accepted and many developing countries are leading the way.

Yet here we struggle to balance the needs of the current generation with our obligations to those who'll come after. Weak legislation and illegal activity lie at the heart of the problem, but it's the farmers on the frontline who really hold the key, and it's heartening to see that many are ready to turn the tide.

As if to underpin just how important native trees are, Elizabeth Ginis's story on the Gondwana Rainforests of Australia serves as a reminder that not all our most spectacular rainforest occurs in the tropics. Within cooee of major population centres along the east coast are big forests of staggering beauty and antiquity. Go see them, spend time walking beneath their green canopies and learn more about the role they play in protecting our water supplies, native biodiversity, capturing carbon and ultimately keeping us all safe. I guarantee you'll enjoy the adventure too.

A dazzling cohort of Australia's most trailblazing adventurers and conservationists will be honoured at our annual Awards night on 1 November at the Shangri-La Hotel in Sydney.
Meet our guest speaker, deep ocean explorer Victor Vescovo on page 96 and then come along and see him in person on that special night.

Chrissie Goldrick

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Notes from the field

Glenn Singleman was "like a kid in a candy store" when asked to join the **Five Deeps Expedition** team. "They planned to use 'the most significant vehicle since *Apollo 11*' to visit the deepest point in the five oceans," he says. "An invitation to join an expedition always means new friendships, new ideas, new places and new experiences in the wilderness." Having had a long association with Glenn at AG, we weren't surprised by his rather exclusive invitation. As a medical doctor and multiple recipient of AG Society adventure awards, Glenn is highly experienced in the needs of extreme adventure. He was also part of the only other recent attempt to reach the bottom of the deepest ocean.

"As an expedition doctor I can't wait to get emails or phone calls about groundbreaking journeys into the unknown," Glenn says. "For me, the raw adventure was supplemented by the scientific possibilities and the responsibility of managing the medical aspects of an expedition thousands of kilometres from any assistance." Fortunately, his professional services weren't needed much and the hugely successful expedition heralded a new era of deep ocean exploration.
For Glenn's exclusive account see page 96.

You don't have to go to the depths of the ocean to find a place on Earth where no-one else has been. The planet's terrestrial environment still has many places left to discover and on page 42 you can read yet another AG-exclusive account of one of them – **Australia's deepest cave**. It's in central Tasmania and the expedition to its depths was →

Notes from the field



sponsored by the AG Society. Like all potentially dangerous adventures, planning was imperative "although it's often hard to plan ahead with cave exploration as it's literally into the unknown," says expedition member Stephen Fordyce. "But thanks to painstakingly collected survey data, our successful connection-by-diving attempt of Niggly Cave and Growling Swallet in Tasmania gave a rare opportunity to pre-empt the outcome, giving us the chance to document all the expedition's details."

From far-flung environments where few or no people have been to distant shores that hum with human culture, we take you to the Torres Strait, where one of the world's most remote communities has survived for millennia (see page 106). Every second year the stunning art and dance of this community is on show to the world at the **Winds of Zenadth** festival. Immerse yourself in this event through the photos and words of Australia's most northern-based journalist Aaron Smith.

After years as a 1990s punk rocker in Melbourne and freelance travel writer, Aaron finally settled in Torres Strait with his family seven years ago. He has since become not just accepted by the locals but embraced by them. "You can't come up here, where English is the second or third language and cultural protocol is complex and different from anywhere else and behave like a big-city journalist," Aaron says. "To come here as an outsider and be accepted enough to be given privileged insight to the local community takes time and mutual respect."

The remote experience isn't always about geographic location. AG writer Elizabeth Ginis felt completely removed from the frenzy of AG's inner-city office during her story on the **Gondwana Rainforests of Australia** (above). "Stretching just north of Newcastle to south-east Queensland, these forests are ridiculously accessible," Liz says. "You don't need to go to the ends of the Earth to experience plants whose ancestors pre-date the ice and dinosaur ages. And once you're immersed in them you really do feel a million miles from anywhere. It's both breathtaking and life-giving."

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More contributors: Noma Bar, Tim Bull, Nick Burningham, Barry Croucher, Adriaan De Jong, Stephen Fordyce, Justin Gilligan, Andrew Gregory, Drew Hopper, Hannah James, Tom Noske, Glenn Singleman, Aaron Smith, Ruchira Somaweera, Victor Vescovo, Thomas Wielecki

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AUSTRALIAN GEOGRAPHIC is printed in Australia by Blue Star WEB, Unit 1/83 Derby Street, Silverwater NSW 2128 under ISO 14001 Environmental Certification.

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Australian Geographic, journal of the Australian Geographic Society, is published six times a year (cover dates Jan–Feb, Mar–Apr, May–Jun, Jul–Aug, Sep–Oct, Nov–Dec) by Australian Geographic Holdings Pty Ltd (ABN 12 624 547 922), 52–54 Turner Street, Redfern NSW 2016. The trademark Australian Geographic is the property of Australian Geographic Holdings Pty Ltd. All material © 2019. All rights reserved. No part of the contents of this publication may be reproduced without the prior written consent of the editor-in-chief.

This issue went to press 12.08.2019

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AG YOUR SAY

September · October 2019

MAILBAG WELCOMES FEEDBACK

Send letters, including an address and phone number, to **editorial@ausgeo.com.au** or to Australian Geographic, GPO Box 4088, Sydney NSW 2001. Letters will be edited for length and clarity.



Featured Letter BOAB MYSTERY

My mate Bill Edwards and I drove a split-screen VW Kombi to Port Hedland in 1968. Here is a photo of Bill topping up the tank while parked in the centre of Highway One somewhere near Broome. No need to pull over, there were very few vehicles before the highway was tarred.

My recollection is that boabs were fewer, and more solitary. I was surprised when I revisited the north-west a couple of years ago to see the proliferation of boabs. There must have been a change favouring their survival. Might it be an alteration of burning-off practices, of cattle raising (cattle are said to enjoy the foliage), rainfall patterns, or some other factor? Your photo of the boab thicket captures it all – the old-man boab that we might have seen in 1968 and an expanding cluster of younger trees. Will the traveller of 2068 see small forests?

Here is another aspect for Emeritus Professor Jack Pettigrew and Prof. David Baum to explore.

Richard Gorrell, Killara, NSW

Postscript

Sadly, Jack Pettigrew was killed in a car accident in May.



WRITE TO US!
Send us a great letter about AG or a relevant topic for the chance to be our featured letter and win an AG T-shirt.

ILL-DEFINED MOMENTS

I have every edition of AG, which I just love reading. My dad gave me a subscription about a year after he started his charter subscription so I had to buy the first few issues later to complete my collection.

Everything seems so well researched and presented that it is a joy to read and learn about something new. However, when I looked at the 150th edition poster, some errors jumped out at me. The first was "Australia's first car", which was actually the Tarrant, way before the Holden. The second was the fact that there where four members of The Beatles, hence their nickname the Fab Four. Lastly, under the newspaper headline KERR SACKS WHITLAM, Gough is not in the illustration. Thanks for a fantastic publication. May it continue forever.

STUART SYMONDS, MAIDEN GULLY, VIC

ED: *We take your point about the car, Stuart, and we thank you for bringing it to our attention, but we can certainly spot Gough Whitlam on there, and a quick look back into history reminds us that Ringo Starr was too sick to fly to Australia with his fab comrades in 1964. Thanks for your eagle eye and we hope you enjoyed poring over the poster.*

BEST YET

I am a retired cultural historian who enjoys every issue of Australian Geographic, since the first issue. However, I must say the latest edition (AG 151) is by far the best issue, as far as I am concerned. Lots of WOW stuff! So much so that I purchased an extra copy so I could share with an American cultural historian. Well done on all the articles but especially *Honeysuckle Creek*, *The End of the climb*, *Generation of change*, *Old town, new prospects* and *Taking the Eyre*.

A great edition. Well done.

DR GEORGE J. TOEPFER, MT STUART, TAS

FINE WRITING

As a subscriber since issue AG1 last century, the article in AG 151 on Uluru compiled and written by Sam Duncan struck me as one of the finest feature articles to appear for many years. Maybe I'm a little biased because a number of years ago I visited Uluru and was totally overcome by its majesty. I walked around it one day and again a few days later (about 10km) each time. To me it has a special spiritual significance and I can understand the locals wishing to end climbing. Because Uluru is positioned virtually in the country's centre it's like its cherished heart.

MATTHEW HOGAN, HURSTVILLE GROVE, NSW

EYE OF THE BEHOLDER

Oh my goodness, I am so mad at you guys right now. I just settled in to FINALLY read my July–August issue (AG 151) and you DARE to suggest on page 22 that the southern myotis and spotted tree frog aren't pretty! They're ADORABLE! And that eastern curlew? How longer do you need those legs and how more doe-y those eyes? So pretty! The little lizard I'd go utterly gaga over if I met one, and, since I'm a macrophotographer, the algae to me is stunning.
You lot have nutty high standards.
On a serious note, thank you for bringing to public attention these less

glamorous creatures. I guess some folks just need to learn to see. Fabulous issue. Absolutely fabulous.

MAGGIE GALBRAITH, CRANBOURNE NORTH, VIC

BALANCING ACT

I really enjoyed the article *Australia's Arks* in the latest issue (AG 151) and appreciated how Tim Low told the whole story of these conservation efforts – the successes and the challenges all together. I think it's that type of balanced telling that is the sweet spot for inspiring constructive action in conservation. I really think too much environment news is either dire "it's all stuffed", or too rosy "yay, we're saving the fluffy animals, it's all good". That is a recipe for apathy and inaction, I reckon. So, well done. And the photos are awesome!

KATH HAFT, ARID RECOVERY, ROXBY DOWNS, SA

ANCIENT AQUACULTURE

A recent article (AG 150) about Brewarrina's fish traps inspired me to write about the first 60,000-plus years of Australia's history from an aquaculturist's perspective. From early European settlement to the present day there has been a lack of recognition and respect for Indigenous farming and aquaculture. Fish barrages built throughout Australian waterways were designed to separate different-sized groups of native fish and also acted as artificial reefs. These were knocked down by colonial settlers to clear the waterways for boats. Publications like Bill Gammage's *The Biggest Estate on Earth* and Bruce Pascoe's *Dark Emu*, when added to accounts of Indigenous Australian aquaculture, paint a very different picture, before European invasion, of an ancient Australian landscape modified and designed by Indigenous Australians caring for country to produce an abundant harvest of plant, animal and aquatic food. It was very convenient for early European invaders to call Australia *Terra nullius* – despite evidence such as the Gunditjmara settlement beside Lake Condah, where there are more than 140 stone houses beside an elaborate eel and fish aquaculture complex. Evidence has been found of ancient hollow smoking trees near Lake Condah where eels were smoked for preservation and trade with other tribes. Since writing an article in 1988 I have been privileged to have been part of the team that helped Lake Condah to be restored to its former size and aquaculture glory after it had been drained in the late 1800s. Just recently the Budj Bim landscape has achieved well-deserved World Heritage listing. Perhaps a future article in AUSTRALIAN GEOGRAPHIC could highlight Lake Condah?

IAN CARSTAIRS, KIAMA DOWNS, NSW



GUIDING LIGHT

I love reading AUSTRALIAN GEOGRAPHIC. The articles keep me up to date, as well as teaching me new facts in every issue. I am passionate about sharing information about our wonderful country with my travellers (I am a tour guide) and I would recommend the magazine to anyone in the tourism industry.

Sandra Dann, Sydney, NSW

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Talkb@ck



In July, we profiled the incredible southern marsupial mole, a peculiar animal of the Australian outback. Here's what you had to say.

TRISH LEE
Wow! I never knew about these little creatures; I know they exist but have never heard much about them. Very interesting article.

CAROLINE NEWLYN
I didn't even know this animal was one of ours; we have some beauts, but this takes the cake.

MICHELE DIX
Our cute little marsupial mole looks as if it is straight out of J.K. Rowlings' *Fantastic Beasts and Where to Find Them*.

MAT SPILLARD
Let's hope we don't make this little fella extinct.

DONALD GILLIS
If it is really weird and not from the Galapagos Islands it's usually from Australia.

WAYNE TAYLOR
Strange even by Australian standards; they could be right under our feet.



Big picture

Surge

By Reed Plummer

Coastlines are dynamic environments, constantly shaped and reshaped by the high energy of breaking waves, like this force of nature crashing down onto the shallow seabed at North Avoca Beach on the New South Wales Central Coast. Taken from above using a drone, this stunning image was a finalist in the landscape category of the 2019 Australian Geographic Nature Photographer of the Year competition. It can be seen, along with all the other best images from this year's competition, at an exhibition at the South Australian Museum, Adelaide, until 10 November and at the Powerhouse Museum, Sydney, until 20 October.



AUSTRALIAN GEOGRAPHIC

NATURE PHOTOGRAPHER OF THE YEAR 2019

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NEED TO KNOW



with Dr Karl Kruszelnicki

Fat birds

FOR MOST OF US, getting fatter has bad health effects.

But it's good for the bar-tailed godwit, which can double its weight in a week or so, and then burn it off again in the same amount of time. The bar-tailed godwit is a large wading bird that breeds on the Arctic coasts and tundra of Scandinavia, northern Asia and Alaska.

Flocks fly south to cross the equator and spend the northern winter in warmer climates, such as in New Zealand. In their search for the eternal summer, forever avoiding winter, they fly north again, leaving New Zealand in March.

There are about 1.1 million of the species worldwide, each 37–41cm long (bill to tail), with a wingspan of 70–80cm. The males (190–400g) are smaller than the females (260–630g).

When birds migrate long distances, they need lots of energy. They get what they need to keep on flying by burning up fat. Your average non-migrating bird carries only 3–5 per cent of its body weight as fat. By comparison, if you fly further, you need more padding.

Birds that migrate short distances carry 20–30 per cent fat. But some long-haul birds really ramp up their body fat to 40–50 per cent.

Our heavy hitter, the bar-tailed godwit, holds the record at a whopping 55 per cent body fat! This gives them enough energy to make them the long-distance flight champions – 11,680km non-stop across the Pacific, in 8.1 days of continuous flight.



Bar-tailed godwit.

To prepare for the flight, bar-tailed godwits do more than just pig out and lay down fat. They can also shrink a few organs not needed for the migration (such as the liver, kidneys and stomach), even while they are flying.

By shrinking away non-essential organs, they can drop their basal metabolic rate by 42 per cent. Any reduction in wasted energy is good when making such an extreme flight.

Another advantage to shrinking these organs is that they provide a source of protein that is useful during the flight.

As long as they can get their obese bodies airborne, not only do godwits get across the Pacific in one single hop, they even arrive for their holiday slimmed down to their perfect beach body.

DR KARL is a prolific broadcaster, author and Julius Sumner Miller fellow in the School of Physics at the University of Sydney. His latest book, *Vital Science*, is published by Pan Macmillan. Follow him on Twitter: @DoctorKarl

For nature's sake

Wildlife artist James Hough donates his time and talent to Tim Faulkner's Aussie Ark through the AGS Art Calendar.



The bush, and its inspiration, is never too far away from James's Maitland studio in the Hunter Valley region of NSW.

IT'S BEEN 30 years since we first published our famous Art Calendar. During that time, many of Australia's finest wildlife artists have contributed to this large-format wall calendar, which, in turn, has contributed funds to wildlife conservation in Australia with $2 from the sale of each donated back to the Australian Geographic Society. We are thrilled to announce that in 2020 we'll be introducing the skills and talents of artist James Hough to our dedicated Art Calendar fans. A member of the international Artists for Conservation group, Maitland-based James, who originally trained as a surveyor, has turned his passion for the bush and its creatures into a full-time pursuit. He's donated 13 paintings to the calendar, and AUSTRALIAN GEOGRAPHIC will donate $2 from each calendar sold to Aussie Ark's captive breeding program. *australiangeographic.com.au/shop/*



PHOTO CREDITS, FROM TOP: SHUTTERSTOCK; SIMONE DE PEAK, NEWCASTLE HERALD
SCIENTIFIC NAME: *Limosa lapponica*



Traces

Bills horse trough, Swan Hill, VIC



A Bills trough with a side dog trough at the Swan Hill Pioneer Settlement.

SWAN HILL Pioneer Settlement is the perfect location for one of the Mallee town's three stone horse troughs, because it still provides water for working horses that are occasionally involved in the living museum's historic re-enactments.

All three Swan Hill troughs bear the inscription "Donated by Annis and George Bills – Australia", as do more than 300 similar troughs scattered mostly around the country's south-east, with a few in Western Australia and Queensland. There are even some as far afield as Switzerland and the UK. Each is a simple but enduring monument to an era when horses were a vital mainstay of everyday life.

These troughs were financed by the Bills Trust, a fund established after the death of George Bills in 1927. After settling in Australia in the late 1800s, British-born George made a fortune in mattress manufacturing. He was a lifelong philanthropist and animal lover. He and his wife, Annis (Swann), had no children of their own and gave generously to a wide variety of charitable causes.

George became a life governor of the Society for the Prevention of Cruelty to Animals in Australia in 1924. His will stated that income from his estate be used for the prevention of cruelty to animals and to provide troughs for working horses.

In 1930 more than 500 troughs were manufactured to a standard concrete design by the Rocla Pipe Company, which then delivered and installed them free of charge in towns and villages that had successfully applied to the trust. The troughs spread far and wide with some installed in arid areas to provide water for camels. Opportunistic native birds and mammals made good use of the freely available water, along with dogs. Some models featured a small dog trough at the side.

By the 1940s horses were fast disappearing from our roads and no troughs were installed after World War II. Today, a few of these troughs still provide water for passing animals while others lie discarded or damaged. But the majority are used as planter boxes.

Have a good look around your district and see if you can spot a Bills trough. If you find one, spare a thought for those thirsty horses of yesteryear and their generous benefactors, George and Annis Bills.

For a list of (known) Bills troughs *billswatertroughs.wordpress.com/*



PHOTO CREDIT: BRUCE COLYER

Oz words

By Kel Richards

Hoon

The *Oxford English Dictionary* records "hoon" as Australian (and New Zealand) slang for a show-off with limited intelligence adding "origin unknown".

Hoon is most often applied to young male drivers who are more interested in attracting attention to themselves than being cautious.

Sid Baker, in *The Australian Language*, suggests hoon might be a contraction from the houyhnhnms (the talking horses in *Gulliver's Travels*). The problem is that the horses are civilised – it's their human slaves, the yahoos, who are the dills. Alternatively, hoon might be a contraction of "hooligan" or, perhaps, a combination of "hooligan" and "goon". Another proposal is that it's rhyming slang for "baboon"; while yet another suggestion is that it's based on "buffoon". All are possibilities, and none are certainties!

DEFINING MOMENTS IN AUSTRALIAN HISTORY

Switch to decimal currency

14 February 1966: Australia introduces dollars and cents

IN 1910 our nation created its own currency based on the Australian pound. Decimalisation had been considered but we followed the lead of Britain, which was firmly against it. By the late 1950s, however, the Menzies government recognised the sense of converting Australia's currency to a decimalised one, in keeping with those of many of our trading partners.

Support for switching came down to practicalities – like its British counterpart, the Australian pound was divided into 20 shillings, each of 12 pence. Financial transactions were complicated. National productivity was also an issue, with research showing decimalisation would annually save our economy at least £11 million, quickly offsetting the £30 million cost of converting.

The main argument against was the Australian pound's symbolic connection to Britain. But after World War II Australians were less wedded to the mother country. In February 1959, treasurer Harold Holt appointed the Decimal Currency Committee to examine decimalisation's merits. Its findings led to the *Currency Act 1963*, which nominated 14 February 1966 as Changeover Day (C-Day), followed by a two-year transition period when both currencies would be legal tender.

Decimalisation gave Australia a chance to create an entirely new currency with a name and design that reflected how the nation saw itself. About 1000 suggestions came from a public competition for a name "with an Australian flavour". These included the austral, oz, boomer, roo, kanga, emu, koala, digger, zac, kwid, dinkum and ming (Menzies' nickname). In June 1963, Menzies, ever the monarchist, rejected them all in favour of the Royal.



Wildlife motifs featured on the new decimalised Australian coins.

This was met with general disapproval but public reaction was more positive when Holt later announced the new currency would be the Australian dollar, divided into 100 cents.

C-Day presented huge logistical challenges. Designs for notes and coins were required, finance sector staff had to be trained and conversions were needed on everything from cash registers to petrol pumps. A public awareness campaign was launched to promote the value of decimalisation, ensure a smooth transition and educate about price conversions.

It was all overseen by the Decimal Currency Board, headed by Sir Walter Scott whose regular national TV appearances offered reassurances about the change. But the campaign's poster boy was Dollar Bill, a cartoon figure who appeared across all media for two years before C-Day. This included a TV commercial called Dollar Bill and Australians Keep the Wheels of Industry Turning, which included a jingle sung to the tune of 'Click go the shears'.

Decimalisation was mostly an easy sell. People were given ample time to adjust to the idea, every potential issue was explained and addressed, and it was hard to argue against its merits.

It was notable that the new currency would be produced entirely in Australia. The federal government had been printing notes since 1913 but to produce enough coins for decimalisation a new mint had to be built; the Royal Australian Mint, in Canberra, was decimalisation's biggest single cost. It opened a year ahead of C-Day and was able to produce and stockpile about 1 billion coins in good time.

Regarding design, Australian wildlife depictions were chosen for our coins; notes were to reflect our history and contribution to the world. To make transition easier, decimal denominations matched to their pound/shilling/pence counterparts – the $1 bill, for example, replaced the 10 shilling note. But the overall look and feel of notes was radically different from what Australians had seen before.

C-Day finally came and went with little fuss. Three months before, hand-picked, well-armed police escorted dozens of semi-trailers loaded with new currency to stock the nation's banks, which closed four days ahead of C-Day to convert machinery and processes. Upon reopening on Monday 14 February 1966, they were able to immediately start issuing new currency to long queues. Even the Decimal Currency Board was reportedly surprised by how smoothly things went.

Australia's experience was monitored by New Zealand and Britain, which switched to decimal currency in 1967 and 1971, respectively. And the success of our decimal conversion paved the way for metrification of our weights and measures in the early 1970s.

PHOTO CREDIT: COURTESY NATIONAL ARCHIVES OF AUSTRALIA

Part of the Defining Moments in Australian History project.
To find out more: ***nma.gov.au/definingmoments***

national museum australia

SPACE

The moon that shouldn't be there

IN THE LAST EDITION OF AG, this column looked at new ideas about the origin of Earth's Moon. But science's fascination with planetary satellites doesn't stop there. Even the furthest planet from the Sun is now giving up its secrets to inquisitive astronomers.

Neptune boasts 14 known moons, with a truly extraordinary range of properties. The seven innermost are the most normal, with orbits closely aligned to Neptune's rotation, suggesting they formed with the planet. Their diameters range from 10s to 100s of kilometres. The outer seven are thought to be captured asteroids and revolve in a much more chaotic manner, with four orbiting backwards – including Triton, which is by far Neptune's largest moon.

Making headlines now is the most recently discovered Neptune moon. Its orbit has been confirmed by scientists at the SETI Institute in California, which allows an official name to be bestowed.

Convention demands that Neptune's moons are all named after Greek and Roman water gods, so the new one is called Hippocamp after a mythological horse-like sea-creature. At 35km in diameter, it is the smallest of Neptune's moons, and all but invisible from Earth. A specially planned sequence of images from the Hubble Space Telescope was needed to establish its orbit.

Hippocamp tracks close to the largest of Neptune's 'normal' moons, Proteus, and conventional wisdom says that it should have been swept out of its orbit by Proteus's gravitation. But a clue to Hippocamp's origin comes from a huge crater on Proteus. This was probably caused by a cataclysmic collision with a comet or asteroid early in the Solar System's history.

The researchers believe Hippocamp is a by-product of that collision, having coalesced from the resulting debris cloud.

FRED ANSWERS YOUR QUESTIONS

Q: Does gravity travel faster than light? If light can't escape a black hole does this mean gravity at the singularity is pulling light back faster than the speed of light? Is the accelerating expansion of the Universe due to gravity having less of an influence on spacetime?
John Brooks, Callala Bay, NSW

A: Great gravity questions! First: No. It's been proved gravity travels at exactly the speed of light. Second: No. It means the black hole (aka the singularity) has an escape velocity greater than the speed of light, so light never leaves it. Third: Sort of. We think the reason we see the Universe expanding faster today than in the past is that the gravitational pull of galaxies on each other is smaller now, due to greater distances between them. That allows 'dark energy' to become the dominant driving force, producing the accelerating expansion.

Scientists have discovered 14 moons orbiting Neptune, eight of which are shown here, since the first was seen by 19th century English amateur astronomer, William Lassell.

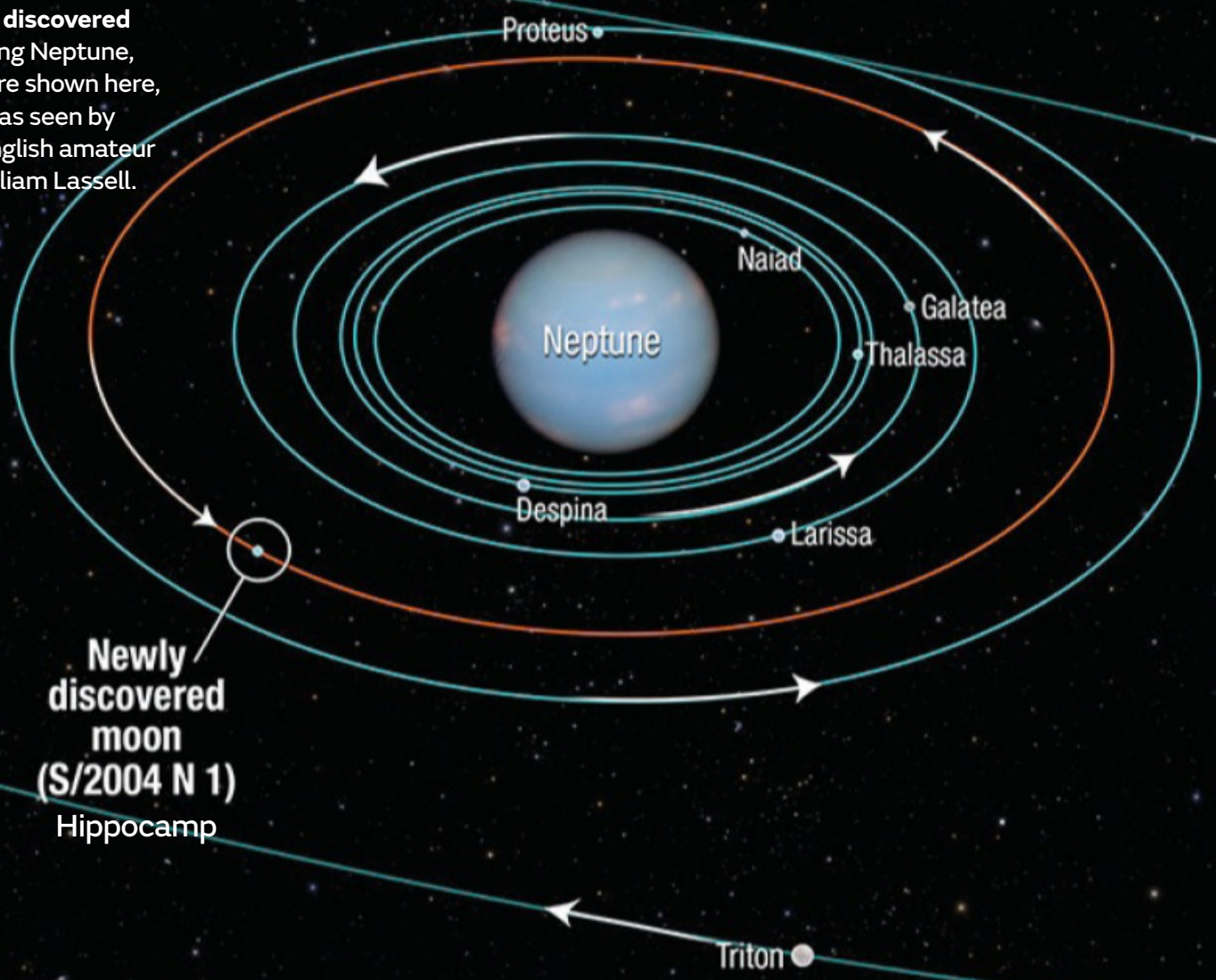


ILLUSTRATION COURTESY NASA, ESA AND A. FEILD (STScI)



FRED WATSON
is Australia's Astronomer-at-Large.

pinetrees
SINCE 1848 • LORD HOWE ISLAND

MEMBER GREAT WALKS of Australia

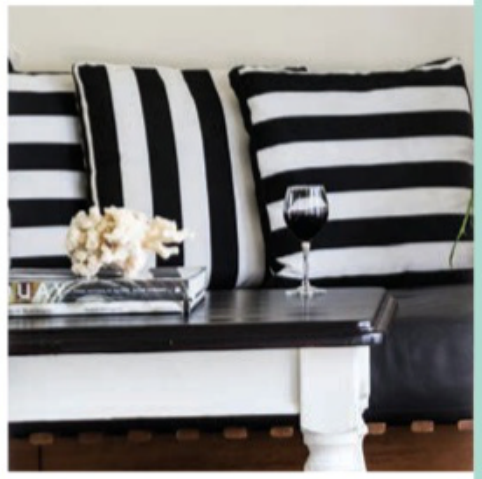
2017 tripadvisor 2018 tripadvisor
TRAVELLERS' CHOICE AWARD
NO.1 HOTEL IN AUSTRALIA

5 out of 5
The Sydney Morning Herald
Weekend Away Review

seven peaks walk









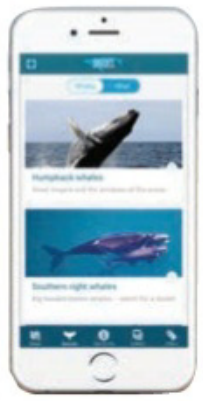
The Seven Peaks Walk is Lord Howe Island's premier 5 day guided adventure that takes you from pristine beaches and exposed coral reefs to the delicate mist forests on Mt Gower. After a memorable day, you'll return to Pinetrees (TripAdvisor's No.1 Hotel in Australia for 2017 & 2018) for a hot shower, cold beer, exceptional 4 course dinner, great wine and deluxe king bed. The walk is for experienced hikers who enjoy a challenge by day, and some luxury by night. Book our Seven Peaks Walk in 2020 and discover Australia's best adventure experience. Please call (02) 9262 6585 and quote 'Australian Geographic'.

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Download

Wild About Whales



Developed by the NSW National Parks and Wildlife Service, this app will enhance your whale-watching experience. It tells you where and when to see whales along the NSW coast as they undertake annual migrations, offers tips to enhance your watching experience and teaches you about species you'll see. You can also post your own images and track the season's sightings. Now at the App Store and Google Play.

Read

Perfect Motion:

How Walking Makes Us Wiser
Jono Lineen
Penguin Random House Australia $34.99
This exploration of walking's evolution and significance to humans is framed by a 2700km solo Himalayan trek, during which the author searched for comfort and closure after his brother's death. He shares walking's transformative nature, linking evolutionary evidence with personal anecdotes from his journey of discovery, solace and finding his perfect motion.

Watch

Encounters at the End of the World

First released more than a decade ago, this exploration of Antarctica by acclaimed filmmaker Werner Herzog is worth revisiting as climate change bites harder. Werner explores the natural wonders of such a desolate, inhospitable region and the lengths researchers will go to protect, research and explore this vast white wonderland. Available to watch on Netflix.

PHOTO CREDIT: COURTESY NPWS. ILLUSTRATION BY BEN SANDERS



Tim the Yowie Man

The five o'clock wave

We now know Australia doesn't have an outback inland sea, but legend says you can still surf a decent wave in inland NSW.

IF YOU'RE on the shady banks of the Murrumbidgee River at Wagga Wagga, in south-west NSW, and spot a tourist with a surfboard anxiously checking their watch, don't worry, you aren't seeing things.

Despite being more than four hours drive from the nearest coast, the sight of a wannabe surfer in boardshorts waiting to hang ten at Wagga Beach (yes, that's its real name) is not uncommon, especially on a balmy summer's afternoon. They're likely to be waiting for the town's infamous five o'clock wave, a sudden surge of water released from Burrinjuck Dam at the same time each day. If some locals are to be believed, it creates a wave so big you can surf it as it travels downstream all the way to Narrandera, some 100km away.

"Usually visitors to Wagga Wagga are surprised to discover an inland city even has a beach to start with," says Fiona Hamilton, Visitor Economy and Events team coordinator at Wagga Wagga City Council. "Many conversations between locals and visitors about our beach are followed up with details about the beach being sandy, and complete with this incredible wave."

It's not only gullible tourists who are regaled with tales of the five o'clock wave. It's also one of the first yarns a new resident to the Riverina town, located 450km south-west of Sydney, will hear...and not just at the pub.



"When I moved to Wagga two years ago, so many locals shared this local phenomenon with me I thought it simply must be real," Chris Longhurst says before confessing sadly that he's never seen the wave.

The reason Chris, or anyone else, has never witnessed the spectacle of a wave roll past Wagga Beach is, of course, that it's a myth. But, like most compelling urban (or rural) legends, it's the story's factual elements that reel in unsuspecting victims.

Adding some credence to the story, for example, is that there really is a Burrinjuck Dam located upstream of Wagga Wagga, albeit 200km away. And water really is released from the dam, which has a capacity of 1 million megalitres (more than two Sydney Harbours), used for crops and pastures in the Murrumbidgee Irrigation Area.

Sounds plausible enough so far. But it's only when you drill into the detail that holes start appearing in the story. First, water isn't released from Burrinjuck Dam at set times. "The release of water is ongoing," says Tony Weber, a spokesman for WaterNSW, the state-owned corporation that operates the dam. "It never ceases, unless in an extreme weather event, like a flood, when release rates may change significantly in order to mitigate the severity of floods."

The final nail in the coffin of this urban legend is that any change in the release volume sufficiently large enough to create a wave is highly unlikely to *ever* occur.

"Any dramatic changes in release flows need to be scaled up and down gradually to prevent bank erosion, equipment and stock loss and other unfavourable impacts immediately downstream of the dam," Tony explains.

Myth busted.

NATURALIST, AUTHOR, BROADCASTER AND TOUR GUIDE Tim the Yowie Man has dedicated the past 25 years to documenting Australia's unusual natural phenomena. He's the author of several books, including *Haunted and Mysterious Australia* (New Holland, 2018). Follow him on Facebook and Twitter: @TimYowie

Bruce Elder's Aussie Towns

New Norcia, WA

This unique settlement, Australia's only monastic town, is a Benedictine religious community in the West Australian wheatbelt.



A statue of St Benedict at the New Norcia Monastery



Stunning interior murals in St Gertrude's College

Origin of the name

When Benedictine monks established a mission on the banks of the Moore River, WA, they named it **New Norcia** after Norcia in Italy, the birthplace of the order's founder, St Benedict.

***New Norcia** is 130km north-east of Perth via the Great Northern Highway.*



NEW NORCIA IS A little piece of the Mediterranean in the Australian bush. It has a monastery, church, hotel, working farm, beehives, wells, schools and an art gallery and museum. It has remained fundamentally unchanged since it was founded by Spanish Benedictine monks in the late 1840s. One historian has written enthusiastically about the settlement: "The quaint beauty of its setting, the old-world model of its architecture, the number, the size, the real magnificence of some of its buildings, excite wonder and admiration. Nowhere else in Australia is there a place like New Norcia, and he who is fortunate enough to spend even a few hours within its hospitable walls will find interest quickened to the liveliest appreciation." It is easy to enjoy the settlement's atmosphere of peacefulness and tranquillity.

Visitor information

Find the New Norcia Visitor Centre, Museum, Art Gallery and Gift Shop on the Great Northern Highway or call 08 9654 8056.
Open most days: 9.30am–4.30pm.
Visit *newnorcia.wa.edu.au*

PHOTO CREDIT, LEFT: COURTESY BENEDICTINE COMMUNITY OF NEW NORCIA. TOP: ANDREW GREGORY (AG)

Things to see and do

1 Exploring New Norcia

One of the best ways to gain an overview of New Norcia is to follow its two short heritage trails, which, combined, take about three hours. Guided tours of the town allow you to see the stunning interior murals in many of the buildings firsthand. Tours depart most days from the Museum at 11am and 1.30pm. For details call 08 9654 8056. On select Saturdays it's possible to visit the Monastery Parlour, enjoy some New Norcia hospitality and meet a Benedictine monk.



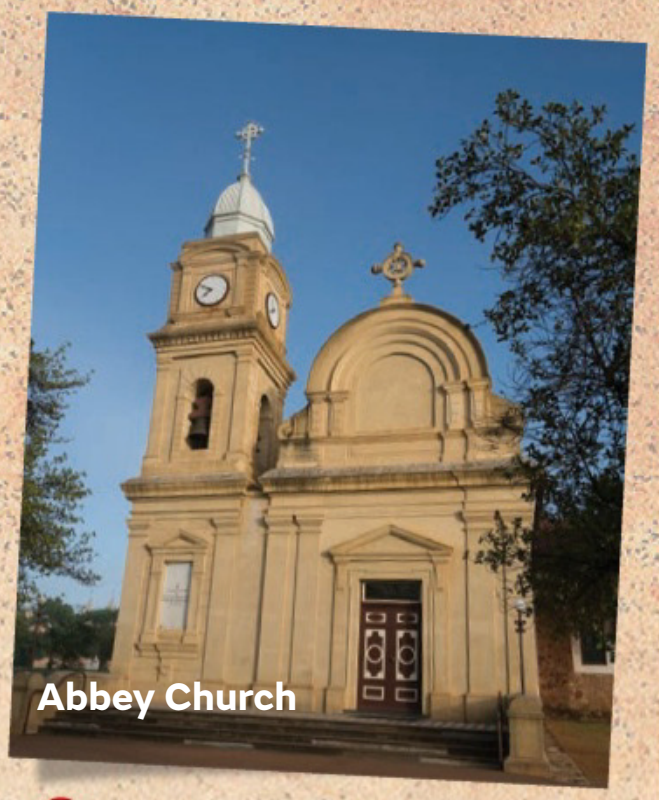
2 St Gertrude's College

Built in 1908 as a convent college for girls and administered by the Josephite Sisters, St Gertrude's is a fine example of Gothic revival architecture. In 1974 it merged with St Ildephonsus' to become coeducational but was closed in 1992. As a college it appealed both to students from surrounding wheatbelt towns and from overseas. Today it can accommodate 200 people and is used for workshops, retreats, conferences and school camps.

3 Museum and Art Gallery



Showing what daily life involved for the monks, the museum includes medical, agricultural and Aboriginal artefact displays. The art gallery has collections of European and Australian religious art and botanical drawings by Charles Gardiner. A shop sells New Norcia produce including olive oil, ale, wine, liquers, bread, biscotti and Dom Salvado Pan Chocolatti. The museum and art gallery are open 9.30am–4.30pm most days.



Abbey Church

4 Abbey Church

Abbey Church is a wonderful example of bush architecture combining stones, mud plaster, rough-hewn trees and wooden shingles. Originally built in 1861 in typically Georgian style, the abbey was given a Mediterranean feel by Abbot Torres' additions in 1908. One of its paintings, *Our Lady of Good Counsel*, was the subject of a miracle in 1847. As a bushfire bore down on New Norcia, Dom Salvado pointed the artwork at the fire, after which the wind direction changed and the abbey was spared.

5 Salvado Statue

This statue of Dom Rosendo Salvado was presented to New Norcia by the Spanish government in the 1960s. Salvado was the founding father of New Norcia. He arrived in 1846, was forced back to Rome in 1849 and then returned in 1853 (with three priests and 37 artisans) to then remain at the monastery until 1900.

6 St Ildephonsus' College

As imposing as St Gertrude's, St Ildephonsus' was designed by Abbot Torres, and its style is Byzantine influenced. It was opened in 1913 by Governor Strickland and originally staffed by the Marist Brothers. The statue in front of the building is of Blessed Marcellin Champagnat who founded the Marist Brothers in France. The Benedictines took over teaching at the college in 1965.

New Norcia timeline

- Before the arrival of Europeans, the area was home to the Yued Aboriginal people.



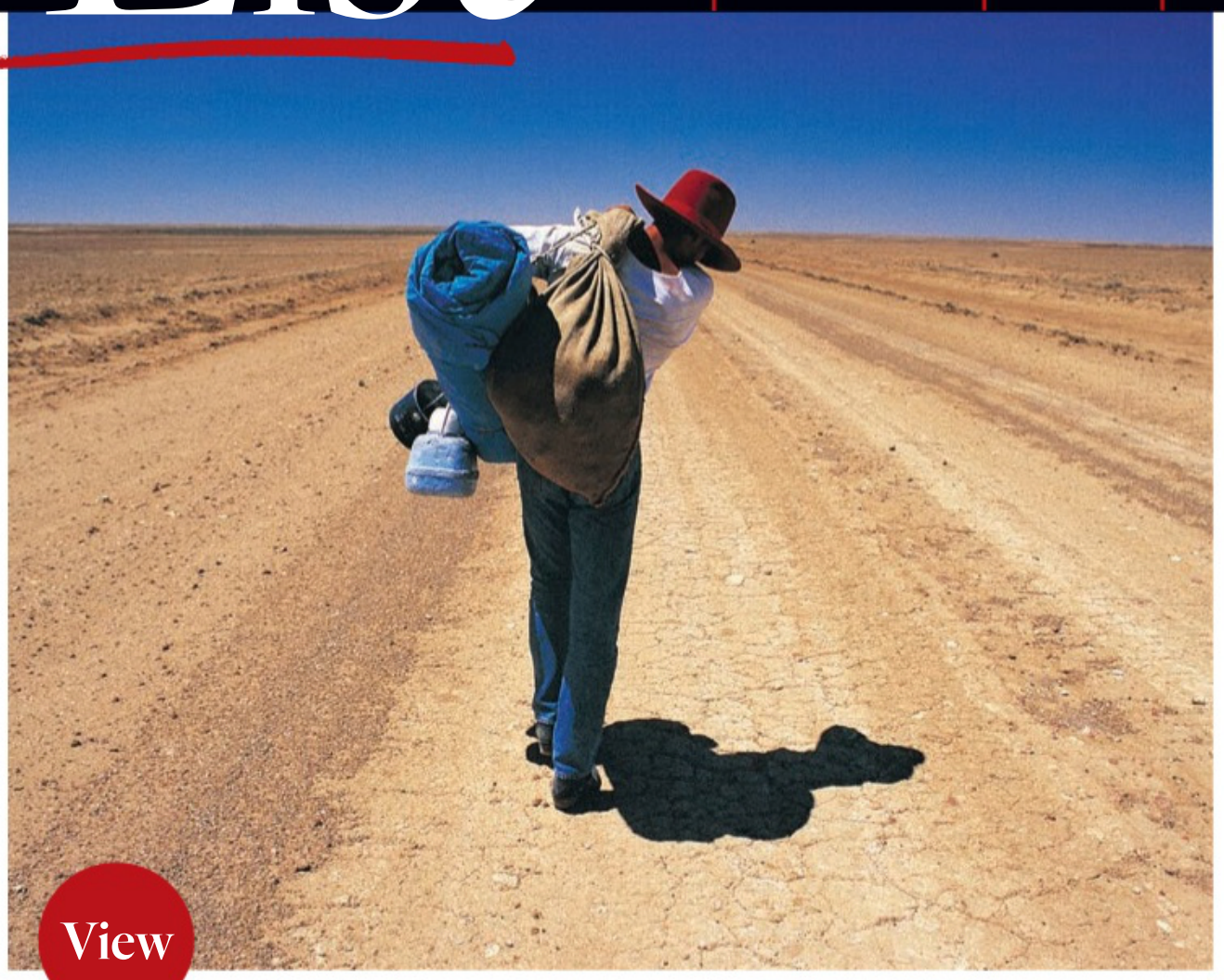
- In February **1846** Dom Rosendo Salvado and Dom Joseph Serra – accompanied by French monk Leander Fonteinne, English monk Dom Denis Tootle and an Irish catechist – set out to travel north of Perth. They established a mission for local Aboriginal people beside a spring about 8km north of the present site of New Norcia.
- In **1847** the settlement was moved to the banks of the Moore River and named New Norcia.
- By **1848** the mission covered more than **1000** acres (404ha) of land and both sheep and cattle were being grazed there.
- The mission grew in importance in the **1860s** and **1870s** as the monks established a series of wells in the area and bred horses and produced silk.
- In **1867** it became an abbey and Dom Rosendo Salvado was appointed Abbot.
- In **1900** Dom Rosendo Salvado died and was replaced by Dom Fulgentius Torres, who was responsible for much of the design and supervision of the new buildings.



- St Gertrude's College was completed in **1908**.
- St Ildephonsus' College was opened in **1913**.

PHOTO CREDITS, CLOCKWISE FROM TOP: AG; COURTESY BENEDICTINE COMMUNITY OF NEW NORCIA; COURTESY BENEDICTINE COMMUNITY OF NEW NORCIA; AG; AG

Since 1988 Bruce Elder has travelled to every town in Australia. He has written more than 10 travel books including the Globetrotter Guides to Australia, Sydney and Queensland; *1015 Things to See and Do in Australia*; and *Explore Queensland* and *Explore NSW*. He worked as a full-time journalist and travel writer with *The Sydney Morning Herald* and *The Age* from 1996 to 2012. Visit *aussietowns.com.au*



View

A Portrait of Australia

Stories through the lens of Australian Geographic

SHOWCASING STUNNING photos from AUSTRALIAN GEOGRAPHIC's acclaimed 30-year anniversary book, *A Portrait of Australia*, this exhibition will be showing publicly for the first time ever, from **15 August to 24 November**, at the Cobb+Co Museum in southern Queensland. Celebrating the bush, outback and coast and the people living there, the exhibition takes you to some of the most rugged and remote parts of the country to tell remarkable stories of ordinary Australians. The Cobb+Co Museum is at 27 Lindsay Street, Toowoomba. *cobbandco.qm.qld.gov.au*

A Portrait of Australia is a travelling exhibition developed by the National Museum of Australia in collaboration with AG. For a venue near you *nma.gov.au/exhibitions/portrait-of-australia*

Australian GEOGRAPHIC
PRESENTS

Come and be inspired. Part of the proceeds will be donated to the AGS.

Hobart will get the chance to hear from some of Australia's most impressive adventurers when the Australian Geographic Society Awards roadshow wheels into town next month.

Hobart

4 September
Stanley Burbury Theatre
UTAS

Eric Philips OAM
Michael Smith
Justin & Lauren Jones

For more information and to book, head to:
australiangeographic.com.au/australian-geographic-presents

looking up

with Glenn Dawes



Glenn Dawes is a co-author of the yearbook *Astronomy 2019 Australia* (Quasar Publishing).

x1 **Naked eye**
A great time to stargaze! In the evening, winter constellations Scorpius and Sagittarius head towards the western horizon. Note the tilting teapot. At about midnight a summer highlight, Orion, is appearing in the east. Look for the saucepan rising.

x10 **Binoculars**
Faint patterns visible under dark country skies can become obvious from the suburbs with binoculars. Try Delphinus the Dolphin constellation; look for the bright star Fomalhaut in the mouth of the southern fish; and follow the body running along Grus the Crane.

x100 **Small telescope**
Mercury has its best evening return for 2019. In mid-September it charges past brilliant Venus to spend October low in the west close to the end of twilight. Watch its phase over this period start out like a round full Moon, shrinking to a thin crescent.

PHOTO CREDIT: COLIN BEARD/AUSTRALIAN GEOGRAPHIC



Australian Geographic Nature Photographer of the Year exhibition

Visit

16 August–10 November
South Australian Museum, Adelaide, SA

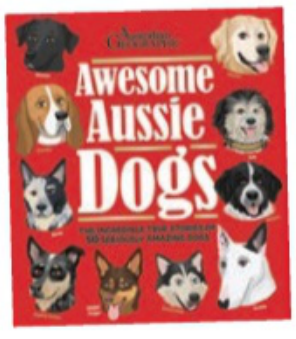
16 August–20 October
Powerhouse Museum, Sydney, NSW

EXPLORE THE SUCCESSFUL entries from the 2019 Australian Geographic Nature Photographer of the Year competition in this prestigious exhibition at two of Australia's most highly regarded cultural institutions. Packed with stunning images of the natural world, the exhibition celebrates the unique bioregion that includes Australia, New Zealand, Antarctica and New Guinea.
naturephotographeroftheyear.com.au

Read

Awesome Aussie Dogs

True stories of 50 amazing Australian dogs



THIS STUNNING new book will be in bookshops from 1 October. It tells stories of working dogs like guide dog Unity (above right). And you'll meet brave heroes like Fizo the silky terrier, who protected his owners from a brown snake, and Rockie the English bull terrier, who dragged his owner out of a burning house, and many more.

Help

Threatened Species Day

Keeping our plants and animals from the brink

THE LAST TASMANIAN tiger died in Hobart Zoo on 7 September 1936 and in 1996, the 60th anniversary of that tragedy, 7 September was declared Australia's National Threatened Species Day. It has since become an annual opportunity to draw attention to the more than 100 Australian plant and animal species that have gone extinct during the past 200 years and the thousands now threatened with going the same way. Events will be underway nationally. To find those near you and more information about species threatened in your state or territory, go to this special site on AG's website:
australiangeographic.com.au/threatenedspeciesdayevents

PHOTO CREDIT, TOP: TESS POYNER
SCIENTIFIC NAME: *Tropidonophis mairii*

Talking Australia

Subscribe and never miss an episode of our entertaining new podcast.

Nick Gleeson
Blind since age seven, Nick (at right with AG Ed Chrissie Goldrick and Unity) is always pushing the limits. He's climbed Mt Kilimanjaro, run the New York Marathon, and crossed the Simpson Desert.

Captain Gary Wilson
As well as captaining cruising ships around Australia, Gary sails replicas of historic boats, such as the 17th-century *Duyfken* and HMS *Endeavour*, across the globe.

Michael Smith
The passionate pilot fulfilled a lifelong dream by circumnavigating the globe in his "flying bathtub".

Professor Lyndall Ryan
Lyndall has mapped the sites of massacres of Aboriginal people committed in the early days of the nation.

Lisa Blair
This resilient and record-breaking sailor circumnavigated Antarctica solo.



Andrew Tink
Andrew sets the record straight about Australia's involvement in Neil Armstrong's first steps on the Moon.

For a full rundown on all of our inspiring podcast guests, including Valerie Taylor, Terri Irwin, Tim Faulkner and Glenn Singleman, head to *australiangeographic.com.au/series/talking_australia*

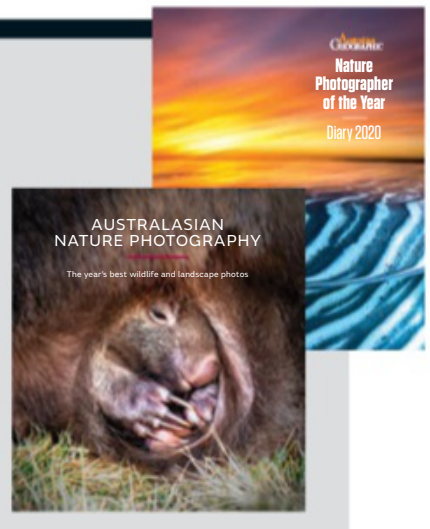
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David Mist spent a year taking photographs for *Sydney: A Book of Photographs*. This photo, he remembers, "was about the look – it captured a certain era of fashion. The businessman guy, you know, all dressed up in the suit with the briefcase, and the kid in the boater."





OUR HISTORY

Swing time

Miniskirts, beehives and boaters made for a memorable image that captures the spirit of an era.

THE SWINGING SIXTIES came a little late to Sydney, remembers David Mist.

"It was much more conservative here," says the British-born photographer, who moved to the harbour city in 1961. "It all came a good deal later than in London."

But by the time he took this photo in the late 1960s, the great cultural upheaval had begun. And who better to document Australia's own liberating 'youthquake' than a hip snapper from the Capital of Cool, who worked for *Harper's Bazaar* and *Tatler* magazines, and played with David Bailey and Jean Shrimpton? David re-created the scene in Sydney, joining the Le Guay and Nisbett photography studio and renaming it Studio Ten, after his former London base, Studio Five. And he enjoyed the burgeoning nightlife, too: "The Cross [Kings Cross] was vibrant – you could go out dancing in clubs and bars, and the personalities of the city… It was fun in its day."

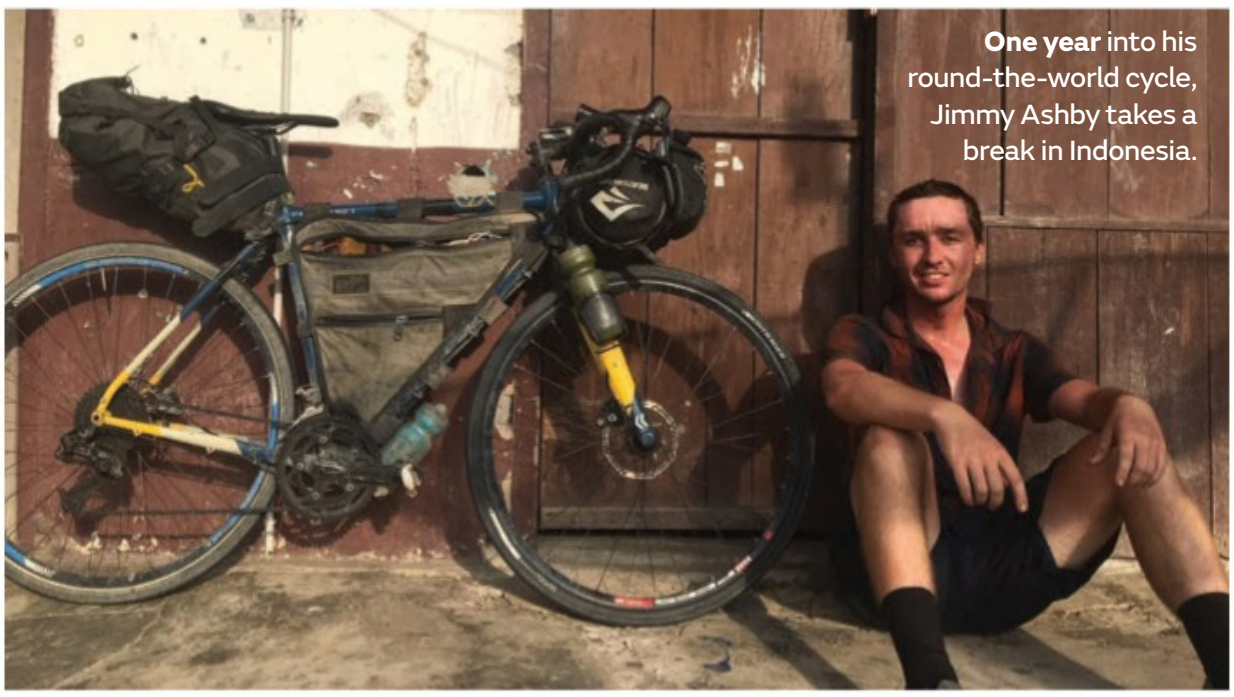
The era-defining quality of David's work was soon recognised, and the Museum of Applied Arts and Sciences now holds two collections of his prints, negatives and transparencies, along with the cameras he used, newspaper clippings and correspondence. In 1968 David was commissioned to create *Sydney: A Book of Photographs*, which features this photo of Milsons Point train station at the northern end of Sydney Harbour Bridge. "There'd been this iconic image Laurie Le Guay had taken many years before called *The Queue*, and it was of a bus queue, all the personalities in it," explains David. "And I was in a car on the Bradfield Highway, and I stopped – you could do that then – and saw those people standing on the platform. I thought they were quite unusual and took the image. It captured a little bit of the time."

HANNAH JAMES

Photograph by David Mist. Collection: Museum of Applied Arts and Sciences. Gift of David Mist under the Australian Government Taxation Incentives for the Arts Scheme, 1996.

Your Society

Australian Geographic Society news and events



One year into his round-the-world cycle, Jimmy Ashby takes a break in Indonesia.

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For more details see page 103

Nominations aplenty for our 2019 awards

Decision time

THE AG SOCIETY'S email inbox always makes for an interesting read. It's where we receive applications for sponsorships and for the Nancy-Bird Walton women's adventure sponsorship. It's also where our funding recipients report back to us on the progress of their adventures or research projects. And at this time of the year it's where we receive nominations for our seven annual awards for conservation and adventure.

We enjoy sifting through the nominations and especially finding out about amazing people who we haven't yet heard of. The deliberations can be difficult, however, because there are so many wonderful and worthy achievements coming through, and it's never easy to choose the winners.

Among some of the fantastic people nominated in 2019 are **Katie Sarah**, a 49-year-old South Australian woman who completed The Seven-Seven by climbing Earth's seven highest mountains and seven highest volcanoes.

Also nominated for adventure are: **Ant Williams** who freedived under the Arctic Ocean, setting a new world record; **Nick Gleeson**, a blind climber and adventurer who completed a three-day solo trek across a not-so-dry SA lake bed in May; and **Jimmy Ashby**,who cycled 35,000km around the world solo at the age of 18.

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Among names submitted for conservation are: **Mina Guli**, founder of THIRST, a not-for-profit organisation that draws attention to water conservation in China; **Brigitte Stevens**, a tireless campaigner for the endangered southern hairy-nosed wombat in SA; **Charlie Veron**, a world-leading coral researcher and expert; and **John Rumney** who pioneered conservation tourism on the Great Barrier Reef.

There are many more worthy nominees who will be considered for this year's awards. We look forward to revealing the names of the winners on these pages next issue and to honouring them in person at the annual awards gala dinner on 1 November in Sydney.

We invite you to join us on that night to be inspired by the stories of the seven medal winners and we congratulate all those nominated for an award this year.

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Sponsorship update

ROUND ONE 2019

Nine individual applicants have received funding from the AG Society in the April round of applications. The dedication of **Simon Cherriman** (pictured right) to the welfare and study of wedge-tailed eagles has no equal in Australia and he's been awarded funds towards his long-term research project based in Mundaring in Western Australia. Simon's a former Young Conservationist of the Year and you may have been fortunate enough to hear him speak at our AG Awards roadshow in Perth earlier this year. Also receiving support for species research is **Dr Bruno Alves Buzatto** of Macquarie University for his research into the deadly but fascinating funnel-web spiders. In the adventure realm, a former Adventurer of the Year, aviator **Michael Smith**, will be re-creating Ross and Keith Smith's epic flight from England to Australia in 1919 in the first airmail race. It's the centenary of this record-breaking flight in December and Michael hopes to follow the route flown by the brothers in their Vickers Vimy plane. In our next issue look out for the story of the historic flight and how you can get involved in the centenary celebrations that will be taking place in the Smith brothers' home city of Adelaide throughout December 2019.



PHOTO CREDITS, FROM TOP: COURTESY SIMON CHERRIMAN; JASON EDWARDS/AUSTRALIAN GEOGRAPHIC
SCIENTIFIC NAME: *Erythrura gouldiae*

AG Society fundraiser

PROTECT THE GOULDIAN FINCH



Populations of the Gouldian finch have declined dramatically. Extensive bushfires in the late dry season in the Kimberley present the biggest threat. These fires destroy tree hollows, which finches use for nesting, and limit the availability of grass seed at key times during the year. The Australian Wildlife Conservancy (AWC) is working to protect the birds across the region. Please donate to help provide effective conservation for the Gouldian finch. Just $100 will fund fire management across 500ha of Gouldian finch habitat.

MAKE A DIFFERENCE. PLEASE DONATE TODAY Funds raised will help support the AWC to protect the Gouldian finch into the future.
Visit *australiangeographic.com.au/fundraising* or call 02 9316 7214.

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THE SOCIETY runs sponsorship rounds in April and November, during which it considers applications and disperses grants that are funded by the Australian Geographic business.

The Society also awards the Nancy-Bird Walton sponsorship for female adventurers and hosts annual awards for conservation and adventure.

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Dawn grazer

By Simon Cherriman

An overnight temperature of –4˚C while camping in Wollemi National Park, north-west of Sydney, made Simon Cherriman reluctant to leave his cosy swag. "But when I peered out to see this grazing red-necked wallaby, I leapt up," he says. "I was very happy it kept feeding long enough for me to dig out my camera from the back of my car." This is one of the stunning finalists in the 2019 Australian Geographic Nature Photographer of the year competition.
See page 62 for the full story.


Southern right whale.

TAS WATCH WHALES MIGRATE, SOUTH-EAST OF HOBART

A series of vantage points along Great Oyster Bay and Frederick Henry Bay off Tassie's east coast are great for spotting humpback whales migrating from warmer climes back to Antarctic waters in September–December. Southern right whales can also be spotted on their journey south, and may linger in September–October. **More info:** call Tasmanian Travel and Information Centre on 03 6238 4222; visit *hobarttravelcentre.com.au*

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In the Australian outback, spring is a great time to enjoy wildlife during the day before intense summer heat sends many creatures into hiding. Find roos en masse in the valleys of Ikara-Flinders Ranges National Park, and look for yellow-footed rock-wallabies around cliff faces and gorges. **More info:** call Wilpena Pound Visitor Information Centre on 08 8648 0048; visit *environment.sa.gov.au/parks*

AUS COUNT BACKYARD BIRDS

Now in its sixth year, the Aussie Backyard Bird Count (21–27 Oct) is a citizen-science initiative that allows you to help estimate bird populations across Australia. **More info:** download the app *aussiebirdcount.org.au/* And don't forget to find out how you can help protect our native wildlife on National Threatened Species Day (7 Sept). **More info:** *environment.nsw.gov.au.*

PHOTO CREDITS: PREVIOUS PAGE, SIMON CHERRIMAN. THIS PAGE, CLOCKWISE FROM TOP LEFT: GETTYIMAGES; COURTESY PETER ROWLAND; SHUTTERSTOCK; SCIENTIFIC NAMES, CLOCKWISE: CLADORHYNCHUS LEUCOCEPHALUS; PELECANUS CONSPICILLATUS

Bird Nerd

with **Peter Rowland**



BOOM AND DUST

Soon after Australia's inland waterways flood, they ripple with breeding birdlife.

MOST OF THE TIME Australia's inland is dusty and dry. Almost 20 per cent of the continent is true desert, receiving less than 150mm of annual rainfall on average. Despite its harsh dry nature, Australia's arid inland supports more than 200 bird species. Some exhibit large fluctuations in population numbers; many are highly nomadic, travelling great distances in search of new food and water sources; while others stay within a short flight of farm dams and other artificial water sources.

Kati Thanda-Lake Eyre, in the north-east of South Australia, is the lowest natural place on the surface of the continent (about 15m below sea level), and is Australia's largest salt lake. It is located within the 1.2 million sq.km Kati Thanda-Lake Eyre Basin, which can be arid for consecutive years.

The unusually heavy rains that fell across inland Queensland and south-eastern Northern Territory earlier this year have travelled thousands of kilometres to the lake, topped up by recent average or above average rainfall over much of the basin.

The predicted depth of more than 2m in the deepest part of the lake (Belt Bay) is well below the 1974 record of 6m. Nevertheless, this rare and unpredictable phenomenon has triggered a mass breeding event of monumental proportions (see *Taking the Eyre*, AG 151).

Millions of waterbirds will breed here, including freckled ducks, black swans and banded stilts. But the largest congregations will belong to the Australian pelican.

This stocky black-and-white bird with a large, pouched bill is Australia's only pelican species. More than 200,000 individuals will breed in the Kati Thanda-Lake Eyre Basin before the floodwaters subside.



Banded stilts are nomadic waders that are often seen on the coast but only ever breed on flooded inland lakes.

Adult pelicans lay up to four white eggs. Chicks hatch after 32 days and take a further three months to fledge. This pelican baby boom is a huge gamble for some: sadly, chicks that are not independent by the time the lake's supply of fish and crustaceans drops too low to sustain them will die of starvation.

Although more often associated with coastal waters, Australian pelicans will breed opportunistically on larger inland lakes. But how do such large numbers know when the normally dry Kati Thanda-Lake Eyre receives enough water to support them? We don't really know.

What we do know is that pelicans soar at about 3000m above the ground, circling effortlessly on thermals and are able to cover vast distances in this way. Perhaps they use a combination of smell and sight to locate large wetlands from these high altitudes, or maybe flocks simply fly over the region and take a look.

However they do it, those of us who witness this incredible sight will never, ever forget it.



Pelicans fly at up to 56km/hr to reach flooded inland waterways to breed.

FOLLOW Peter on Twitter: @_peterrowland and Instagram: _peterrowland

NATURE

Birds struggling to be heard

Noise pollution in urban environments is drowning out birdsong, making it ever harder for birds to communicate.



BIRDSONG ISN'T just beautiful to the human ear. Often complex and melodic, it's a vital tool used by species such as European robins, Australian magpies and silvereyes to communicate with one another, aiding reproduction and survival. Birds with powerful, vibrant songs are more likely to attract mates and protect territories from intruders.

We already knew conventional pollution, such as plastics and chemicals, poses a problem to urban wildlife, but it turns out that – for birds at least – noise pollution is also insidious. Several studies have explored this problem, with some even suggesting noise pollution, from sources such as traffic and industry, could be contributing to declining bird populations.

One new study, from Queens University Belfast in the UK, found that the behaviour of European robins changed when they were subjected to human-made background noises. Male robins sing to compete with one another for territory and nesting space, using complex compositions to advertise aggressiveness and fighting ability. Combatants then make decisions about conceding or defending positions based on opponents' songs.

But the din of urban environments is making it ever harder for such messages to be communicated, meaning male robins may concede too easily or fight too vigorously, says Dr Gareth Arnott, a lead author on the study, which was published in the journal *Biology Letters* in June.

"We found that bird song structure can communicate aggressive intent,



There's so much in urban environments to confuse birdlife, from windows and mirrors to human-made noise.

enabling contestants to assess their opponent, but noise can disrupt this communication by masking the structural complexity of songs," the scientists wrote. "This suggests that under noisy conditions, birds may be limited in their ability to use song complexity to defend or acquire resources, such as territory."

Gareth says the research shows human-made noise pollution is affecting wildlife more than we might think, having unexpected implications for how animals communicate – possibly even affecting survival and population numbers in some species.

But there's evidence birds are fighting back against the racket. Research from the University of Melbourne published in 2011 showed some urban songbirds were singing more slowly, loudly and at a higher pitch than members of the same species living in more rural or bushland environments.

Led by birdsong expert Dominique Potvin, the researchers studied 14 silvereye populations across south-eastern Australia, finding that urban birds sang and called at a higher pitch, so they could be more easily discerned above traffic and other background noise. These changes were thought to have been made through both learnt behaviour in song composition and evolutionary changes to the briefer calls that birds made.

Some birds with naturally high-pitched calls, such as the grey fantail, may have little need to adapt their calls because they can be clearly heard above traffic. But research suggests other Australian birds, including rainbow lorikeets, eastern rosellas and grey shrike-thrushes, are more likely to sing at a higher pitch in urban environments.

It's not only bird communication that suffers in environments plagued by human-made background noises. A study of western bluebirds, mountain bluebirds and ash-throated flycatchers in Colorado, in the USA, found that birds nesting near noisy gas compressors had hormone levels equivalent to those in humans suffering from post-traumatic stress disorder.

A 2018 paper published on the work in the journal *PNAS* says this may be because birds caring for young were unable to detect signs of predators above the noise, and were therefore constantly on alert, eventually becoming exhausted.

Gareth says there are important implications to consider around noise pollution and wildlife protection. When we think of bird conservation, we now need to factor in background noise levels, not simply find suitable habitat with tree cover.

JOHN PICKRELL
is a former AUSTRALIAN GEOGRAPHIC editor.
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The featherless neck of the southern cassowary is brightly coloured in blues, reds and purples, which are more vivid in females. The two loose skin flaps that hang below are known as wattles, the function of which remains unknown.

Jungle royalty

Australia's cassowaries aren't as rare as we thought but there's still much to discover about these enigmatic rainforest birds.

STORY BY **JOHN PICKRELL** PHOTOGRAPHY BY **JUSTIN GILLIGAN**



Australian Geographic Society Supported

THE WORLD'S SECOND-HEAVIEST bird remains shrouded in mystery. Living in the shadowy world of northern Queensland's ancient rainforests, the southern cassowary still sometimes surprises scientists and wildlife carers with unusual and rarely documented behaviours.

For example, there's the question of diet. Although cassowaries mostly eat fruits and seeds, they occasionally add a little protein from fish, crustaceans and even roadkill, says Wren McLean, an ecologist and conservation scientist with the Rainforest Trust in Mullumbimby, northern New South Wales. "They are known to go fishing by lowering themselves into a freshwater pool and opening up their feathers. They allow the small fish to come in and eat their dead skin cells," says Wren, whose cassowary survey work has been supported by the AG Society. "Then they close their feathers, step out of the water, shake themselves and pick up the little fish."

Dr David Westcott, a CSIRO zoologist based in Atherton, Queensland, who has studied cassowaries for many years, agrees "the different strategies they use to get a balanced and non-poisonous diet are interesting". Being almost entirely frugivorous (fruit-eating) can be difficult, because many basic nutrients are poorly represented, so cassowaries "have to really be quite clever", he says. To this end, cassowaries have been seen eating road-killed bandicoots, while the remains of crabs and even small birds have been found in cassowary faeces.

Ingrid Marker, a long-time wildlife carer at the Garners Beach Cassowary Rehabilitation Centre, run by Rainforest Reserves Australia, has been in almost daily contact with cassowaries for about three decades and has also seen several unusual behaviours. On one occasion, she saw a chick make a vocalisation that she believes indicated a hawk in the sky above. "The male looked up and then puffed himself up like a pufferfish, and the chicks ran underneath him, and they walked back into the canopy," Ingrid says, adding that cassowaries have a series of different calls for different threats. ▸



▲ **Fragmentation of rainforest** habitat is leading to a declining southern cassowary population. It's also resulting in more interactions with people: this hungry uninvited guest turned up for dinner near Mission Beach in the heart of QLD's Cassowary Coast.

BECAUSE CASSOWARIES SPEND most of their time in dense forest away from the prying eyes of researchers, it is not surprising that we still know so little about them. "For a huge bird with bright colours, they only need to take a few steps off the road into shady rainforest and you can't see them," Wren says. "They are difficult to spend time observing and studying."

The bird's elusive nature has also made it difficult to accurately assess the species' population size. The first comprehensive survey in the Wet Tropics of Queensland – a World Heritage area that stretches from just south of Cooktown to almost Townsville and represents the core of the cassowary's range in Australia – was carried out by a team of CSIRO scientists led by David and published in 2014. The researchers collected DNA from scats to extrapolate the number of individual birds in the region and the results surprised everyone by revealing a population of up to 4500 cassowaries.

This was great news, because some earlier estimates suggested as few as 1500 were left. "We had the numbers really wrong," Wren says. "We were actually very pleased." In 2017 the revised estimate led to the species conservation status being downgraded from Vulnerable to Least Concern on the IUCN Red List.

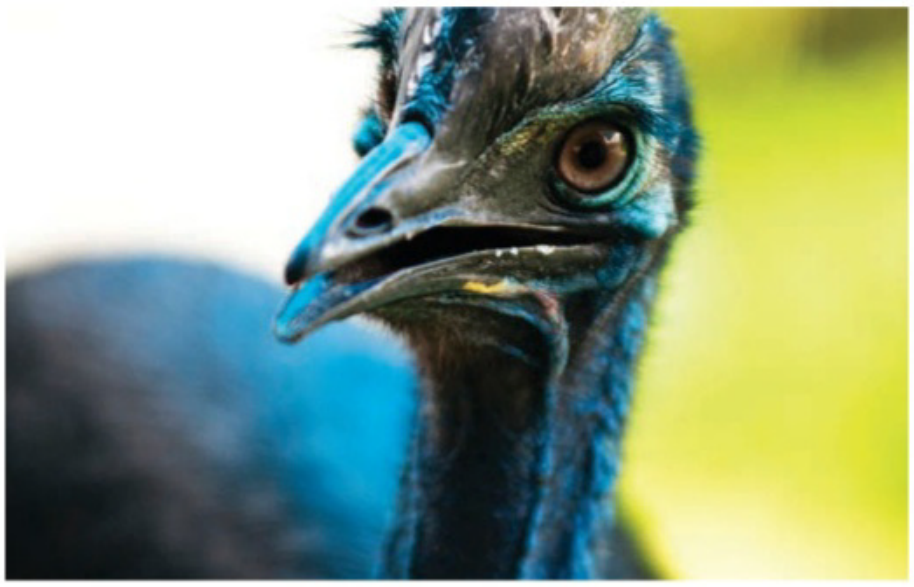
Both Wren and David have been involved in recent surveys on Cape York Peninsula, working alongside traditional-owner groups. While most of Australia's cassowaries live in the Wet Tropics, there are several smaller, little-studied populations in isolated rainforest pockets further north. The southern cassowary is also found in New Guinea (alongside the northern and dwarf cassowary species), where the population numbers 15–45,000 and suitable habitat covers an area about 15 times that in Australia.

To learn more about cassowaries in Cape York's McIlwraith Range, 450km north of Cairns, Wren created visual lures – fake rainforest fruits – to attract cassowaries to camera traps (see Your Society, AG 149). The images helped her identify individuals and also captured previously unseen behaviours in both chicks and male–female pairs.

Cassowaries are culturally important for many far north Queensland Aboriginal groups, including the Ayapathu, Kaanju,

The bird's elusive nature has also made it difficult to accurately assess the species' population size.

Southern cassowaries are normally shy and harmless rainforest birds. But during territorial disputes or when threatened, they'll strike out with their feet. They have a sharp elongated claw on each foot capable of killing a large animal.





Lama Lama, Umpila and Wik-Mungkan of the Coen region of Cape York Peninsula; and the nine Indigenous groups represented by the Girringun Aboriginal Corporation, whose lands lie between Mission Beach and Townsville. Several of these groups are now involved in cassowary conservation, using traditional ecological knowledge in concert with modern science.

Known as Kutini to the people around Coen, and Gunduy or Gundulu to some groups further south, cassowaries are integral to Dreamtime narratives and traditional lore, and feature in stories, ceremonies and dances. Cassowaries were also once a valuable food source and played an important role in rainforest seed dispersal, helping to ensure a constant supply of new fruit for people to forage.

Tim Jaffer, executive director of Kalan Enterprises, which represents traditional owners around Coen, says that when they began to think a decade ago about how best to manage the land recently returned to them, one focus was the rainforest uplands of the McIlwraith Range. "It's where the creeks come from and the rivers flow out of that [to] join the country up," he says. "Lots of bush materials are collected in the rainforest and there's lots of wildlife there and cultural stories associated with those animals. The southern cassowary is one of them."

Working alongside scientists such as David, Kalan rangers have been involved in 15 or more field trips over six years that have provided an estimate of 170–400 cassowaries in the range.

PHOTO CREDIT TOP: DAIVD BRISTOW; BOTTOM: DON FUCHS

The facts on southern cassowaries

SCIENTIFIC NAME: *Casuarius casuarius*
Originally derived from the Malay "kesuari", which comes from the Papuan words "kasu", meaning horned, and "weri", meaning head.

SIZE: **Adults grow to 2m tall; males weigh up to 55kg and females up to 76kg. The heaviest ever recorded weighed 85kg.**

BREEDING: Cassowaries mate in June–October. Females lay clutches of 3–5 pale-green eggs 2–3 months later. Males brood these for a further 50 days before they hatch.



CHILDCARE: **It was once thought males did all the parenting, but there are increasing accounts of females visiting males and chicks.**

DIET: Cassowaries have been recorded to feed on at least 238 different plants. They prefer fallen fruits, but will also eat flowers and mushrooms as well as snails, insects, fish, crabs and other small animals.


Cassowary plums.

FEATHERS: **Cassowary feathers differ from those of other birds in that they lack tiny barbules to hold feathers in shape and have a central quill that's split down the middle.**

TERRITORY: Documented ranges vary between 52ha and 235ha, but can be much bigger.

ORIGINAL POPULATION SIZE: **Based on the amount of habitat lost in the Wet Tropics, the cassowary population may have been up to twice its current size before European colonisation.**

SEED DISPERSAL: By eating rainforest fruits, cassowaries play a major role in the dispersal of seeds. In particular, they are important for large-seeded plant species.

FEET: **Cassowaries have dagger-like claws that can be up to 12cm long, on the central of the three toes on each foot. When threatened, they can use these to defend themselves, jumping and kicking forwards with both feet.**





Living on a rainforest-clad property in prime cassowary habitat near Mission Beach, conservationist Ingrid Marker has seen firsthand the grisly results of many wild dog–cassowary interactions.

Most adult cassowaries that come into care at the rehabilitation centre have been hit by cars.

Some of the biggest threats here are climate change, uncontrolled bushfires, feral cattle and pigs. "Feral cattle spoil waterholes and we know that cassowaries need water to cool down in the top of the dry season," Tim says.

FURTHER SOUTH, in the Wet Tropics, the conservation challenges are different. Here the birds are killed in significant numbers by vehicle strikes and dog attacks. Ingrid says that in the past two years alone, she has responded to 18 reports of cassowaries mauled by dogs around Mission Beach.

She's often unable to recover a body, so the true scale of the problem doesn't figure in official statistics. There's a culture, she says, of owning aggressive dogs for hunting feral pigs and "putting them in your ute to go running around on a Friday and Saturday night is a huge recreational pastime". Dogs are sometimes let loose in cassowary habitat, although it's illegal, and "any animal that happens to get in their path is often preyed upon".

However, most adult cassowaries that come into care at the rehabilitation centre, which can house up to 18 birds, have been hit by cars. If one is struck at 50km/h it has a good chance of surviving, Ingrid says. But those hit by cars doing 100km/h have almost no chance. Juveniles and chicks orphaned through dog attacks, some just 2–3 days old, are also commonly admitted.

The last time the facility was inundated with injured and sick birds was following Cyclone Yasi in 2011.

"There wasn't a leaf on a tree, and if the cassowaries survived the falling of the debris then they were subjected to starvation," Ingrid says.

"In a natural situation, they could have walked from the coast up into the mountains, where there's still plenty of fruit around, but in the fragmented landscape in which they now live they can't move across country."

Keeping cool

THE FUNCTION OF a cassowary's casque – its head crest – has long been debated. Until recently, it was thought to help the birds determine the direction of sounds, such as deep vocalisations from distant cassowaries or rainforest fruits crashing to the ground. However, new findings, published in *Scientific Reports* in January 2019, suggest it acts as a kind of radiator, enabling the birds to shed heat more efficiently. "Just as humans sweat and dogs pant in hot weather or following exercise, cassowaries offload heat from their casque," says study author Danielle Eastick of La Trobe University in Melbourne.



The cassowary's casque starts developing from the age of about 12 months. It's made of a spongy material surrounded by a hard keratin.

Most of the centre's birds are released once they're healthy. Because of habitat fragmentation, carers are cautious about release locations. These need ample food and water and no other cassowaries, because they're solitary animals and very territorial. Local traditional owners and the scientists are often consulted.

At the centre, human contact with the birds is minimised. Young cassowaries are fed a wide variety of fruits, hidden in their enclosures to make them challenging to find. Carers hope the birds' instinctive behaviours will be strong enough for them to forage successfully once released. "In reality, they aren't going to be as comfortable in the wild or as knowledgeable as a wild bird," David says. "So they're always going to be at a bit of a disadvantage, and we don't have a good understanding of how well they do after release."

INGRID SAYS ONE reason cassowaries get hit by cars is they're in no hurry to get off the road. "People think they are stupid," she says. "[But] what they are is arrogant. They are the queens of the jungle and don't move out of the way for anybody."

Females are particularly assertive and territorial, Wren says. She once climbed a tree, heart pounding, to escape one intimidating her. These intelligent birds are highly attuned to anything going on within their realm, she adds, telling the story of being slowly escorted out of a cassowary's territory during survey work: "I was walking along a river and she was walking behind the vegetation, 10m behind me, calling regularly. When I crossed the river, she came out of the foliage and stood there staring at me for ages."

David says peacefully observing a cassowary at a distance as it goes about its daily activities is a wonderful experience: "A bird has tolerated my presence for hours on end on a few occasions and it's always a really peaceful and privileged feeling." AG

ILLUSTRATION: KEVIN STEAD

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The Day 1 party, just before setting off: (L-R) Stephen Fordyce, Serena Benjamin, Gabriel Kinzler, Alan Jackson, Stefan Eberhard (sitting) and Fraser Johnston.



Delving into Tasmania's underground

Cavers discover a flooded subterranean passage that sets a new record for Australia's deepest cave system.

STORY BY **STEPHEN FORDYCE** ILLUSTRATION BY **BARRY CROUCHER**

FOR MORE THAN AN hour I'd been pushing through the silty, submerged tunnel, using the rock walls to guide me. The water was cold and in places the passageway was uncomfortably tight. I was searching for a way through a flooded passage deep within Niggly Cave, on the Junee River near Mount Field National Park, north-west of Hobart, Tasmania. I'd left the expedition team I was part of at the edge of a pool at the cave's end: known as a terminal sump, it's the furthest point cavers can access before the tunnel becomes submerged.

I was diving alone and looking for an orange string guideline I'd used to mark my route through a different cave, the nearby Growling Swallet, four years earlier. Back then, I'd dived some 500m along a narrow tunnel before reaching the predicted limits of my breathing gas supply.

I'd severed my guideline there and secured its end to some rocks before heading back. Now I was trying to find that point from what I hoped was the other side. If I could reach that old guideline and prove the two caves were connected, our team could show that this cave system is the deepest known in Australia.

The height of a mountain is measured from sea level to the summit but the depth of a cave system is determined by calculating the height difference between its highest and lowest points. So, if you're chasing a cave depth record – trying to find the deepest cave – it makes sense to explore upwards, looking for high points, and downwards, looking for low points, but it also makes sense to search sideways.

If you can find a link between two nearby caves, proving they are joined, then you can combine the ▸

PHOTO CREDITS, THIS PAGE: FRASER JOHNSTON; OPPOSITE: STEFAN EBERHARD

The Mount Niggly rockpile towers over our camp.

There's no escape from admin, even camped 350m underground. Plotting survey data on a smartphone helped dictate plans for the next day.





Finally kitted up and having just about run out of excuses, it was time for one last photo.

With the connection made and the team reunited, a round of cheesy high-fives seemed appropriate.



Niggly Cave

highest known point of one and the lowest of the other to chart a new depth for the system. And that was exactly what I was trying to do.

In this remote, lonely place, I felt nervous: about being so far from home, about whether I'd missed the connection point and about whether the old line had washed away. Suddenly, I spotted the old orange guideline I'd left behind years earlier. I swam over and tied it to the line I was using to mark my route now. It was a satisfying connection, literally.

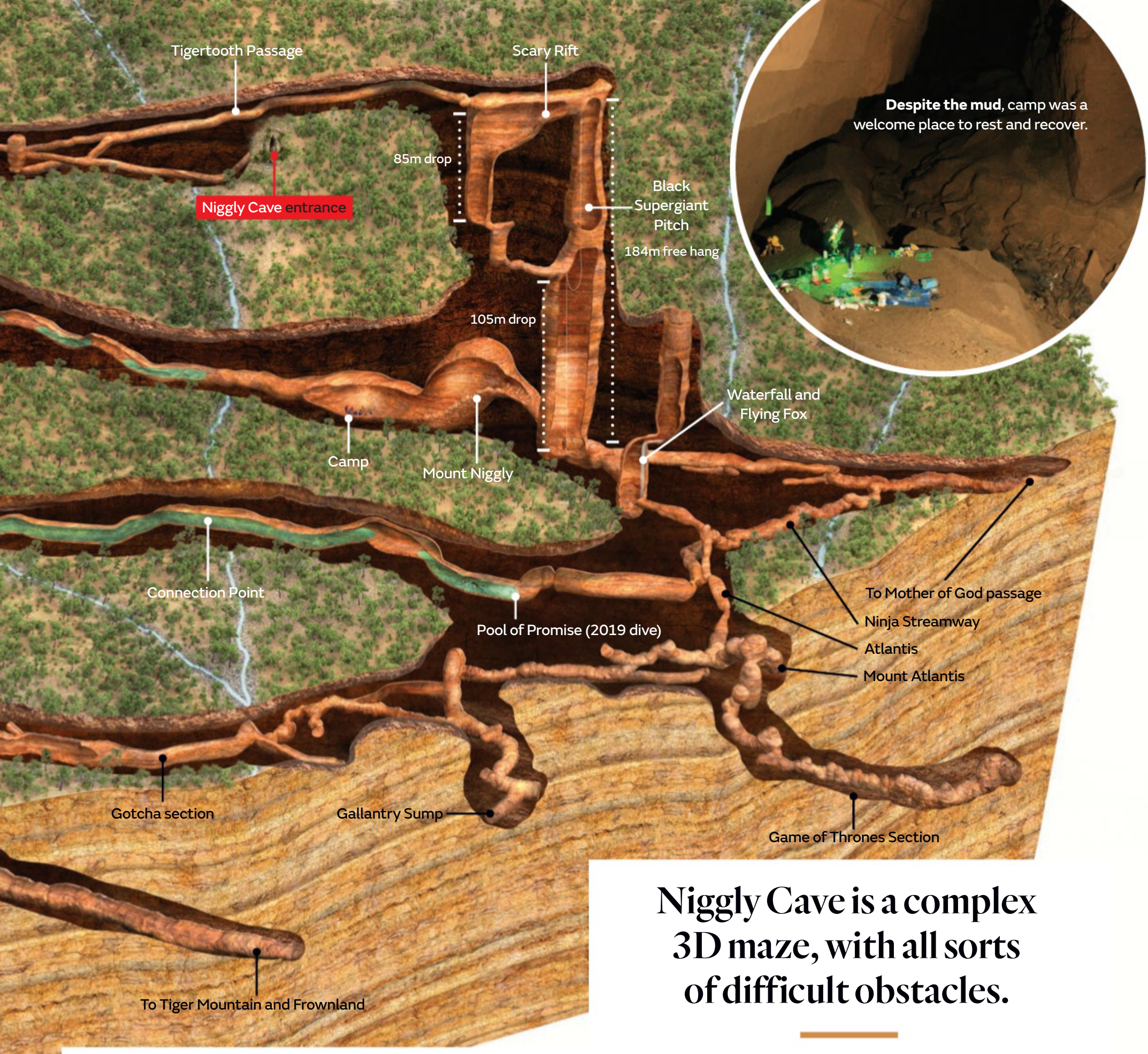
With this dive, our team had discovered a link between the Niggly Cave and Growling Swallet systems. And by proving the caves are joined, we'd set a new depth record of 397.7m for Australia's deepest cave system. That may seem trifling compared with the deepest cave in the world – Veryovkina Cave in Georgia, which is more than 2200m deep – but finding the connection point fulfilled a decades-long quest by cave explorers to learn where and how two of Australia's deepest caves join up.

OUR EXPEDITION in May involved four days underground in Niggly Cave. Niggly is part of the Junee-Florentine karst, which is home to more than 600 documented cave entrances and contains most of Australia's deepest caves. I was part of a 10-strong expedition crew of cavers – speleologists – from Southern Tasmanian Caverneers (STC) caving club.

Being an experienced caver and technical diver, I was the expedition's push diver. Unlike regular cave diving, push diving involves exploring previously uncharted areas, with the help of support personnel. There can only be one such diver on an expedition like this because of the huge effort it takes to haul a complete set of diving gear through to the terminal sump. We'd spent most of Day 1 getting to the sump: hiking through temperate rainforest to reach the cave's mouth, squeezing through narrow subterranean passages in the cave's upper sections, abseiling down vertical shafts deep within the cave, and zipping over an underground waterfall on a flying fox we'd installed previously.

STC members have been exploring caves in Junee-Florentine for many years. In early 2015, I'd dived Dreamtime Sump, the pool at the end of Growling Swallet. It was the precursor for our May expedition. When the Dreamtime tunnel had become too remote to pursue, we'd resolved to try from the other side. But nobody knew where the stream entered Niggly.

PHOTO CREDITS, TOP LEFT: STEFAN EBERHARD; BOTTOM AND INSET: FRASER JOHNSTON



Despite the mud, camp was a welcome place to rest and recover.

PHOTO CREDIT: STEFAN EBERHARD

Niggly Cave is a complex 3D maze, with all sorts of difficult obstacles.

In the following years, many of Australia's toughest cavers spent countless days looking for the stream inlet in Niggly, with no luck. But during an expedition last December, a group of us managed to negotiate our way through a rock-choked section in an unexplored part of Niggly that we named Ninja Streamway. It opened up into a spectacular large passage we called Atlantis. Exploring on from there, we discovered the Pool of Promise, where I'd started our breakthrough dive. We suspected the submerged tunnels in this sump might eventually connect with the Dreamtime Sump tunnel I'd explored in 2015.

A DIVE LIKE THIS is a huge team effort. The push diver has an important role, but the dive is impossible without others helping. Niggly Cave is a complex 3D maze, with all sorts of difficult obstacles. And both the air and water temperature are only 7°C. Cavers must be fit and experienced to make it down, and able to carry a load of up to 20kg.

Our team was Alan Jackson, Gabriel Kinzler, Stefan Eberhard, Serena Benjamin, Fraser Johnston, Petr Smejkal, Patrick Eberhard, Chris Sharples, Rolan Eberhard and me. The expedition required extensive planning and preparation. In the lead-up, I completed a full dress rehearsal at Mornington Pier, my favourite dive site in Melbourne, and tried to emulate everything I could about the upcoming dive: I wore all my gear, laid guidelines and stayed under water for two hours – about as long as I expected the Niggly dive to take.

We'd planned to spend four days underground, camped at a depth of 350m. The first day would be spent descending into the cave and making our way to the Pool of Promise, where I'd attempt the connection dive. Days 2 and 3 would be spent exploring new dry passageways, and searching for a way past the chamber I'd discovered and named Business Class Lounge during a previous trip. I'd reached it via a submerged tunnel, and because it was only accessible by diving it remained largely unexplored.

Gearing up

Exploratory cave diving requires extensive training and experience, as well as some special equipment to ensure diver safety and maximise the chance of success.

Thermal protection

- **Drysuit (to keep the diver's body completely dry)**
- Layers of warm undergarments
- **7mm-thick neoprene hood (to keep the diver's head warm)**
- Heated wetsuit gloves

Recording equipment

- Surveying gear (compass, wrist notes and dive computer with depth gauge)
- **Helmet-mounted camera**
- Knotted guideline (for measuring distances)

Diving equipment

- **Lightweight composite cylinders (two cylinders hold enough breathing gas to fill 1500 balloons)**
- Nitrox (nitrogen-oxygen gas mixture)
- **Reels of guideline**
- Silt pegs (for securing guideline)
- **Helmet with mounted lights**
- Spare lights
- **Spare diving mask**





All our equipment is carefully selected. Every piece must be able to be carried, dragged through squeezes, lifted up ropes, dropped on rocks, covered in mud, submerged and/or potentially left in the damp environment of the cave for what could be years at a time.

On the fourth day, we'd haul our gear back up 250m of ropes to the surface and navigate our way back through the series of squeezes in the cave's upper sections. One particular section, the 500m-long Tigertooth Passage, was so narrow we would need to walk sideways, with protruding rocks likely to snag loose straps and gear with frustrating regularity.

THE DIVE DIDN'T begin well. It was 8.45pm before we were set up at the Pool of Promise and I was ready to jump in. I started pushing through the tunnel, reached a dead end almost immediately, backtracked through my own silt cloud and managed to find and follow the left wall. I made good progress before the wall pinched away. Ahead of me was a horizontal slot – between the silty floor and the rock ceiling above there was a gap of only about 25cm. It was my best option for forward progress.

I'd been securing my guideline as I made my way through the cave, but this section was a classic cave diver's 'line trap' – where the guideline could easily get dragged sideways into the impossibly low passage. If this happened, I could get into trouble when following the guideline on my return. I pegged it to the floor with silt pegs and was progressing forward, lying flat between the floor and ceiling with my head tilted sideways because there wasn't enough room for me to keep it upright.

Clouds of silt obscured my vision, but I was moving forward through the water, when my reel of guideline ran out. I fumbled blindly with thick gloves to switch reels and then charged ahead, surfacing quickly in a large, dry chamber. I made a solid tie-off on a rock protrusion above the water and added an arrow as a reminder of the way out.

At the far end of the chamber was a small cobble beach, and just beyond, a tiny pool with barely enough room for me to put my fins back on, but while the passage forward was low, it quickly opened up into a large underwater cave.

I knew I was close when my second reel of guideline ran out – we'd calculated the distance to the connection point would be about 220m. After 200m, my uncertainty was growing. Then I saw the guideline I'd tied off years earlier. Here, finally was the connection many cavers thought would never happen.

By combining the lowest point in Growling Swallet with the highest point in Niggly Cave, we established that this cave system is 397.7m deep, a new depth record for an Australian cave.

Niggly Cave and Growling Swallet have plenty of secrets left to discover. This summer we may attempt a complete through-trip from one cave to the other. If not, we'll definitely be back. AG

WATCH To see footage from this expedition and from a documentary that's in production, head to *tartarusfilm.com*



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Splendid protection

Kept safe by a quarter of a century of World Heritage listing, the Gondwana Rainforests of Australia are an unparalleled glimpse into an ancient wilderness.

STORY BY **ELIZABETH GINIS**
PHOTOGRAPHY BY **DREW HOPPER**

The spectacular Dangar Falls, Dorrigo, is one of an abundance of cascading drops along Waterfall Way, the road that links the northern NSW region's Gondwana rainforests.

Wearing a coat of moss and lichen, this aged tree in New England NP embodies the ancient and other-worldly nature of Gondwana rainforest.





Dorrigo NP's Skywalk provides visitors with the perfect perspective of the tangled rainforest canopy. Facing east, it also showcases the Bellinger Valley with its densely wooded hills and lush paddocks that meet the ocean.

DIRECTLY OVERHEAD, on outstretched wings, a wedge-tailed eagle floats. It's just a metre or two away and, if I reach up, I can almost stroke its broad golden chest.

Nearby, a high-country river plummets once, and then again, over the double drop of a mighty waterfall. It pummels a deep pool 100m below and in the doing spreads a shimmering mist across the rock-strewn gorge. The eagle turns, glances down at me, and glides away. It rides the updraughts of a wind that ruffles the canopy of a rainforest, whose inhabitant species are as old as the hills it covers.

In this tangle, towering trees stand dressed in coats of the softest, emerald-green moss. These are the ancients – descendants of another place, another time. This is Gondwana country, and, like my soaring feathered friend, it's breathtaking.

Dorrigo National Park

In the hinterland behind Coffs Harbour, on the New South Wales mid-north coast, sits one of the country's 40 World Heritage-listed Gondwana rainforest sites. Here the trees are bent and bowed, gnarled and knobbly, smeared in lichen, and dripping with vines.

Just an hour's drive south-west of Coffs along Waterfall Way, Dorrigo National Park is one of the most accessible places to explore these forests. Centuries-old Antarctic beech rub shoulders with prehistoric tree ferns and palms, and you can wander on well-maintained tracks and boardwalks admiring their grandeur.

As we meander along Crystal Shower Falls walk (3.5km return), George Bradford, the NSW Parks and Wildlife Service (NPWS) supervisor at Dorrigo Rainforest Centre, explains the importance of these forests. "Gondwana Rainforests of Australia include the most extensive areas of subtropical rainforest in the world," he says. "Extending from north of Newcastle [a two-hour drive north of Sydney] to the south-east of Queensland, these World Heritage-listed areas are thriving with plants and wildlife and are an outstanding example of the major stages of Earth's evolution."

When Australia finally broke from the supercontinent Gondwana, it took with it one of Earth's greatest collections of ancient plants and animals. As it drifted further north it grew hotter and drier, forcing the wet and often dark forest that covered most of its surface to retreat to the mountains and damp corners of the east.

Today, Australia is home to traces of this original ark. While many plants from that time are found on the

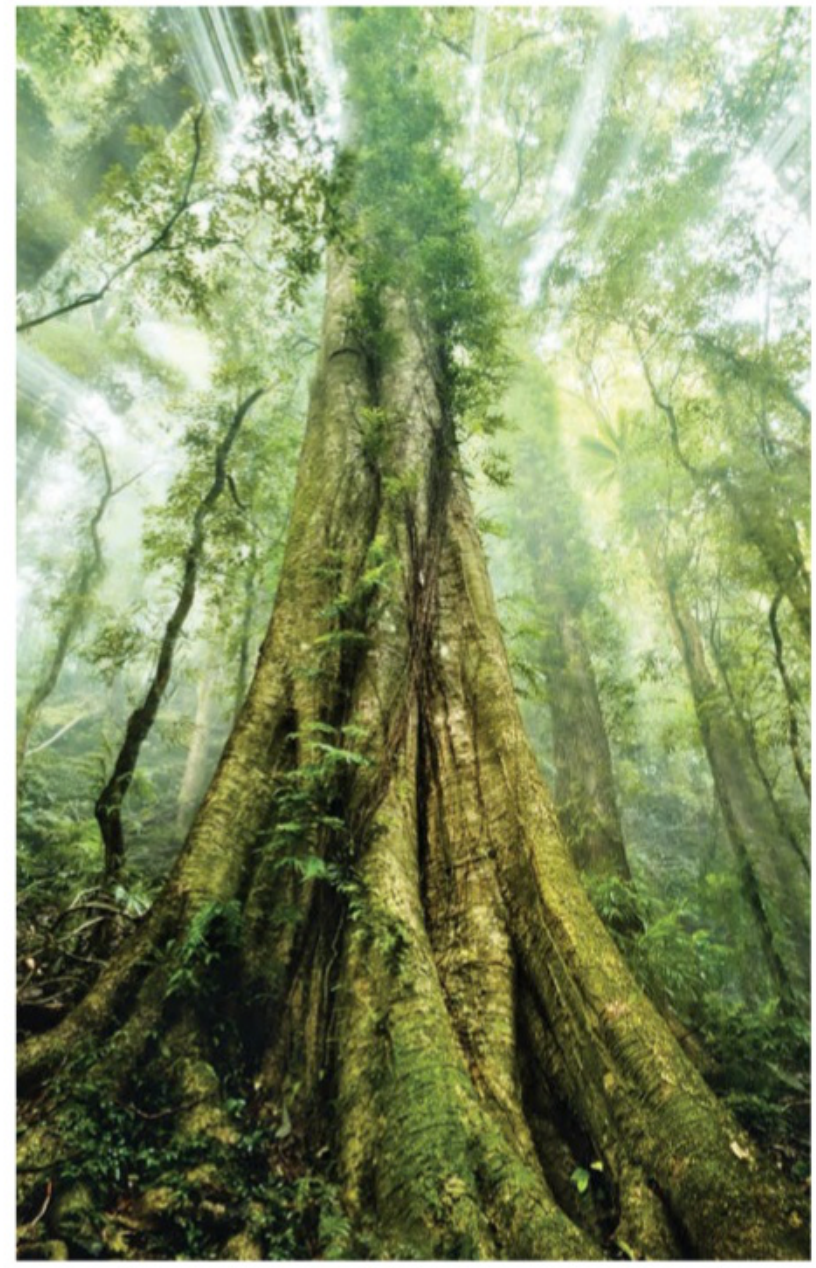
NSW NPWS supervisor at Dorrigo Rainforest Centre George Bradford suggests a wander on the Wonga Walk and to Crystal Shower Falls to immerse yourself in the rainforest.





Wander the Walk with the Birds Boardwalk in Dorrigo NP and see how many of the park's 150 species of bird, including the tawny frogmouth, you can spot.

The buttressed roots of a fig tree are shrouded in afternoon mist as the sunlight breaks through the canopy and illuminates lush foliage in Dorrigo NP, NSW.



"Gondwana Rainforests of Australia include the most extensive areas of subtropical rainforest in the world."

continents of South America, Africa and Asia, it's the rainforests of Queensland, NSW and Tasmania that have the best examples of plants whose lineages date back beyond the Age of Dinosaurs.

It's 10am on a crisp but blue-skied winter's day and the forest glistens. Under the canopy of the rainforest it's cooler still and the sunlight that warmed us on the park's Skywalk – a 70m-long raised walkway on the edge of the Dorrigo escarpment – is heavily filtered. Fingers of golden light reach through the upper branches and around the heavy trunks, caressing the leaf litter on the forest floor.

"Everything has its place in these forests," George says. "From the grand old beeches to the southern angle-headed dragon clinging to a tree trunk, it's evolved over millennia to exist in harmony." He stops to point out a lime-green frond of a tree fern, delicate in its unfurling and perfect in its symmetry.

"The first ferns appeared nearly 365 million years ago and brought with them evolutionary innovations, including roots and leaves," George says. "It's astounding to think they're still here today."

A few steps further on and I'm marvelling at a superb lyrebird that's just drifted into view. It's a male, George tells me, pointing out its tail, which it fans out in spectacular fashion when courting a female. "And they're incredible mimics," he says, admiration in his voice. "They're superb by name and by nature."

Deep in the rainforest, George stops again. "We'll pop out in a minute at Crystal Shower Falls," he says. "Head on over the suspension bridge and we can walk behind the waterfall."

We do, and find ourselves standing in a large rocky cavern that's smeared in moss and sits behind a torrent of water, the spray wetting our faces. It's sublime.

An hour later we're back on the Skywalk, standing on the 21m-high elevated structure and gazing out across the rainforest canopy and beyond, to the picturesque Bellinger Valley – its verdant hills and paddocks run to the sea.

Continued page 58

Visit New England NP in spring for its profusion of wildflowers, including these golden everlastings, its eucalypt forests and ancient rainforest.



Dorrigo National Park

Getting there

When to visit: year-round

Dorrigo NP is a six-hour drive north of Sydney, or five-and-a-half hours south from Brisbane, and is the starting point for your Waterfall Way exploration of the Gondwana Rainforest Area of Australia. While no accommodation is available in the park, you can stay in the nearby town of Dorrigo.

New England National Park

When to visit: year-round

Where to stay

1. The Residence – *sleeps 8*
2. The Chalet – *sleeps 5*
3. Toms Cabin – *sleeps 8*
4. Thungutti Campground – *20 sites*

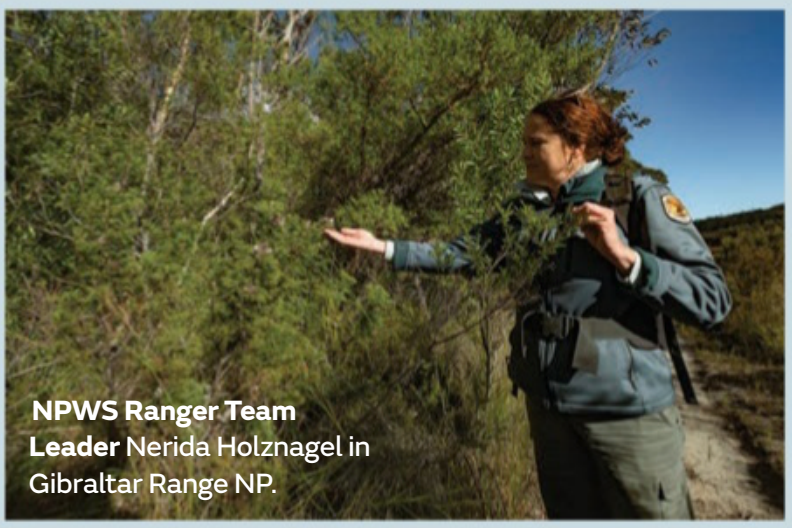
Washpool/Gibraltar Range national parks

When to visit: spring and summer

Where to stay

5. Gibraltar House – *sleeps 7*
6. Mulligans Campground – *15 sites*
7. Boundary Falls Campground – *6 sites*
8. Bellbird Campground – *15 sites*

More information/bookings:
nationalparks.nsw.gov.au/gondwana-25; 1300 072 757; download the NSW National Parks app



NPWS Ranger Team Leader Nerida Holznagel in Gibraltar Range NP.

The multi-tiered drop of Ebor Falls is just minutes drive off Waterfall Way in the farming hamlet of Ebor, roughly 50km west of Dorrigo NP.



Spring The forest is brimming with life in spring, from fields of vibrant wildflowers to animals galore. The dense forest is the ideal hiding place for reptiles – be very quiet and patient in order to catch a glimpse – while the canopy is a veritable cacophony of birds: look for white-throated tree creepers, rufous fantails and powerful owls.

Summer Escape the sweltering seasonal heat and immerse yourself in the cool air and vibrant greens of the Antarctic beech rainforests covered in moss. Enjoy a picnic and walk under the canopy, and then cool off with a dip in one of the creeks that flow through the parks and eddy in natural pools.

Autumn Enjoy the fresh-air walking during the day and cosy nights by the campfire during these cooler months.

Winter Wildflowers attract a smorgasbord of native birds, including Lewin's honeyeaters and eastern spinebills. Discover the spectacular icicles and frozen rock faces along creeks, particularly at Weeping Rock (New England NP), and enjoy having the parks largely to yourself.


FACT
The Gondwana Rainforests of Australia provide habitat for more than 200 rare or threatened plant and animal species.
FACT
These extraordinary areas contain ancient and primitive plants and animals from which life on Earth evolved.
AREA ENLARGED
NEW SOUTH WALES
Featured national parks
Other national parks
World Heritage Area
0 5 10 15 20 25 km
Gondwana Rainforests of Australia WHA
WASHPOOL NATIONAL PARK
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HAT HEAD NATIONAL PARK
Bellbird Campground
Gibraltar House
Boundary Falls Campground
Mulligans Campground
Sugarloaf Point
Black Mtn
Mt Gundahl
Mt Mundy
Red Herring Hill
Mt Hyland
Bold Top Mtn
Round Mtn
Table Top Mtn
Duftys Knob
Jacobs Ladder
Double Head Mtn
Mt Banda Banda
Mt Werrikimbe
Mungay Mtn
Whip Mtn
Viewmont Mtn
Billygoat Knob
Mt Gladstone
Thungutti Campground
The Residence
The Chalet
Toms Cabin
Wollomombi Lookout
Walk with the Birds Boardwalk
Skywalk
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Crystal Shower Falls
Ebor Falls
Wollomombi Falls
Chandler Falls
Dangars Falls
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Emmaville
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Ulmarra
Coutts Crossing
Minnie Water
Diggers Camp
Wooli
Red Rock
Corindi Beach
Glenreagh
Mullaway
Woolgoolga
Sandy Beach
Nana Glen
Emerald Beach
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Coffs Harbour
Dorrigo
Sawtell
Bellingen
Mylestom
Urunga
Valla Beach
Hyland Park
Nambucca Heads
Bowraville
Macksville
Scotts Head
Taylors Arm
Stuarts Point
South West Rocks
Smoky Cape
Gladstone
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Crescent Head
Pacific
Ocean
Range
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Taylors Arm
BRUXNER HIGHWAY
GWYDIR HWY
NEW ENGLAND HWY
ARMIDALE ROAD
WATERFALL WAY
PACIFIC HWY
ORARA WAY
CLARENCE WAY
KEMPSEY ROAD
THUNDERBOLTS WAY
OXLEY HIGHWAY
GUYRA ROAD
ABERFOYLE ROAD
A15
A1
B76
B91
B78
B56



Standing at Point Lookout, 500m or so from my lodgings, watching the sun peek over the dawn horizon is mesmerising.

The view is dominated by the double peak of McGraths Hump, which is also known as Old Man Dreaming. In Aboriginal Gumbaynggirr legend, it shows the profile of a warrior's face, Ngali. It was Ngali's job to protect women who came to give birth in the valley. But he fell asleep, and for his punishment he was turned to stone for all eternity.

New England National Park

Some might say mid-winter is not the ideal time to explore this high-country park. And on the surface they may well be right. But, aside from the cold, it delivers many gifts. For starters, there are no snakes.

The roaring fire in my accommodation, The Residence, is also the perfect full stop to a day of bushwalking through incredible stands of ancient forest.

About an hour's drive west of Dorrigo NP along Waterfall Way, New England is a sprawling expanse of tangled Gondwana rainforest, snow gums and spectacular views.

Standing at Point Lookout, 500m or so from my lodgings, watching the sun peek over the dawn horizon is mesmerising. Pinks and purples paint the ranges, which lie like sleeping giants before you, and the mist pushing through it all makes the panorama both eerie and intoxicating.

Visit Point Lookout as the sun rises and be treated to a spectacular and changing palette of colours creeping across the heavily wooded ranges in New England NP. Hidden within these hills are some of the world's most ancient forests.

The park's altitudinal range, 150–1563m above sea level, makes it suitable for many different animals. On the drive in, there are eastern grey kangaroos grazing a few hundred metres from the road and wallabies enjoying a sunbake in patches of cleared ground around the ranger's hut. I even see a spotted-tailed quoll: after forgetfully leaving some fruit outside overnight I awoke to gorging quoll sounds.

There are also more than 100 bird species in the park, including eastern spinebills, Lewin's honeyeaters, rufous fantails and white-throated tree creepers. I don't see many of them on my day's wanderings, but hear their melodies bouncing off branches.

Perhaps most memorable is my walk to Weeping Rock. A gargantuan slab of basalt, it looms large and drips with water. I stand here, dwarfed by the 30m high rock face, and imagine it's a mother crying for her lost child – tears that never cease.



Organ pipe-like rock formations flank Ebor Falls and are topped by a walking track that takes in views of the surrounding wilderness. Wedge-tailed eagles soar on thermals here and brush-tailed rock-wallabies frequent the rocky ramparts.

About halfway up the side, ice has formed on mossy patches and is clinging to grasses and vines.

In particularly cold years, icicles can hang like stalactites for months on end. In warmer months, I'm told, you should listen for the long, creaking growls of the rare sphagnum frog that lives in cracks in the rock face or burrows into the moss.

Like Weeping Rock, the steep cliffs of the plateau edge in New England NP were born from at least five basalt lava flows from the Ebor Volcano, forming a rim more than 300m thick. Active until about 18 million years ago, this huge volcano was set around a semi-circular ridge in the Bellinger Valley and you can see it from Point Lookout. Years of erosion has created the dramatic escarpment of today.

Protected deep within the valleys below the escarpment are Gondwanan survivors – the beeches, tree ferns, palms, vines, lichens and more. On the way back from Weeping Rock I stop to take photo after photo of the other-worldly scene laid out before me: buttress roots so large you can stow away in the spaces between them, branches adorned in old man's beard, and cycads standing to attention.

You can lose yourself here, and I do, for hours, musing over the provenance of these species – how they got here and have survived ice ages, dinosaurs and, perhaps most pressingly, humankind.

I find part of the answer the next day, at Wollomombi Falls, a 40-minute drive further west in Oxley Wild Rivers NP. It's an impressive gorge, etched from the surrounding basalt by the Wollomombi and Chandler rivers. Yet if you didn't know it was there, you'd drive right on by. Surrounded by cleared farmland, which looks barren and ravaged by overgrazing and drought, it's both protector and refuge for Gondwanan species according to NPWS ranger Alan Hill.

"The sheer cliffs mean it's largely inaccessible to people and animals, although feral goats didn't seem to get the memo," Alan says. "Because of this, little communities of ancient rainforest species are left to their own devices, to grow, to flourish and to regenerate."

Both Wollomombi and Chandler falls sit at the northern end of the gorge, and drop vast volumes of water hundreds of metres into the ravine below. It's so deep that huge boulders look like pebbles, and aged trees appear

Be sure to tear your eyes away from the ancient giants of the Gondwana rainforest to appreciate its many smaller gifts – colourful fungi sprouting from moss-licked logs – in Dorrigo NP.



Washpool and Gibraltar Range national parks are an easy drive from Grafton and Glen Innes. The latter is dotted with impressive granite boulders including Anvil Rock (at bottom).





no more statuesque than saplings. But Alan assures me the Gondwanan relics will stay safe here for aeons to come. "A rockslide might take some of them out, but they've been surviving long before we arrived, and will do so long after we are gone," he says. "They're stayers."

Washpool and Gibraltar Range national parks

Nerida Holznagel is a powerhouse. The NPWS Ranger Team Leader is striding it out ahead of me, carrying a 20kg pack, as we head into the heart of Gibraltar Range National Park, roughly an hour's drive east of Glen Innes. We walk through eucalypts, casuarina and black she-oak en route to Anvil Rock (4km return), an impressive granite tor with hulking boulders set atop.

As we go, birds flit from a stretch of golden sub-alpine swamp on one side of the path, to the other where there is a dry eucalypt forest. We stop to admire the banksias, bottlebrush and winter wildflowers in bloom. Further on, xanthorrhoea leaves splay upwards and outwards, and small granite boulders stage gravity-defying balancing acts. It's an easy walk, and the conversation is even more so.

"I don't think people realise how accessible all this is to them," Nerida says. "I mean, we have some of the world's most intact and ancient rainforest right at our fingertips. It's not locked up. It's here, a short walk from your car."

Further on we reach Anvil Rock, and clamber over its elephant-grey surface to find a hidey hole between two huge boulders. From this vantage point I spy Old Mans Hat, another striking rock formation. It's perched on the next ridge and between the two, in the crease of a stream, sits a lush green strip of tall, open, wet forest dominated by eucalypts and well-developed rainforest understorey.

"This part of the park isn't strictly Gondwanan," Nerida says. "But it's vital for the rainforest's survival. Here we see rocky outcrops, like Old Mans Hat, grasslands and hanging swamps give way to dry and wet forests that in turn, give way to the rainforest. Amazingly, it's like Mother Nature has set up physical barriers to help protect the jewel in her crown – the emerald rainforest."

The next day, Nerida and I head out on the 8.5km Washpool walking track, which will take us on a round trip to one of the largest stands of coachwood forest in NSW. It's frigid and breezy, and ice crackles underfoot

Nerida Holznagel stops off at one of her favourite spots on Coombadjha Creek in Washpool NP. "It's the perfect place to cool off in summer, whether you're staying at the nearby camping ground or visiting for the day."

on frozen grass. But my attention soon turns from this to marvelling at the wilderness around me.

Summit Creek wends through the forest, bubbling around rocks, carrying leaf litter downstream, and dropping over waterfalls every so often. Before long we're admiring towering red cedars. Their distinctive flaky bark creates useful perches for many plants, while epiphytes such as bird's-nest ferns and orchids, fungi and vines transform these trees into multi-layered gardens.

Looking up along the trunk of one – roughly 30m tall – my eye finds a beard of strangler fig roots dangling from its upper branches. "Old man whiskers," I say to Nerida.

"Old man for sure," she replies. "The trees in this stand are about 1000 years old. Can you imagine what they've seen throughout the years?"

A nearby sign explains what they survived during the 1800s and 1900s, the pioneering days of the region: "Red cedars were known as red gold and drew timber cutters with bullocks, axes and crosscut saws. It has no equal as a material for furniture, cabinets, panelling, staircases and other interior fittings.

"Historically, the search for red cedar contained elements of the fanaticism for which goldmining is renowned. Often it wasn't monetary gain that drove loggers on but the challenge and satisfaction in locating and winning the 'king of all trees' from the great rainforest in which it grew."

Standing there, dwarfed by these majestic 'kings', I'm beyond thankful that the bullocks and crosscut saws no longer reign supreme, and the "great rainforest" is now protected by the warm embrace of Washpool National Park.

"Few places on Earth contain as many plants and animals that are so closely related to their ancestors in the fossil record," Nerida says. "And these amazing places show us how both are continuing to evolve. Washpool and the Gondwana Rainforests of Australia are refugia. And we must always protect them." AG

TO SEE MORE PICTURES and footage by Drew Hopper of the stunning Gondwana Rainforests of Australia, go to *australiangeographic.com.au/issue152*

THANK YOU to NSW National Parks and Wildlife Service and Isuzu (*isuzuute.com.au*) for their assistance with this article.



AUSTRALIAN GEOGRAPHIC
NATURE PHOTOGRAPHER OF THE YEAR 2019

PRESENTING PARTNER **CORAL EXPEDITIONS**

STILL LIFE

Technology meets artistry and opportunity to produce the winning images in this year's Australian Geographic Nature Photographer of the Year competition.

OVERALL WINNER

FIN WHALE'S DEMISE

FIN WHALE, *BALAENOPTERA PHYSALUS*
STATUS: VULNERABLE

Mat Beetson, Western Australia

The fin whale is sighted regularly in this region; seeing one beached, however, is rare. The whale sits less than 5m from shore and 100m from residential homes, giving whale researchers access to an unusual occurrence for this species. Bronze whalers and great whites feasted over the remains before removal.

Cheynes Beach, Albany, Western Australia

DJI Phantom 4 Pro Drone, 24mm, 1/500, f/5.6, ISO 100, 118m high, filmed with permission of The WA Department of Biodiversity, Conservation and Attractions.

Despite seeing millions of nature photographs over the decades, we have never seen anything that remotely resembles this image. Unique and exciting, it reveals incredible beauty in death. Rather than being an inanimate scene, the image is given life by the circling shark, which in turn reminds us of the ecological function of the dead whale, providing food and energy to the living organisms around it. The image surprises by revealing such a shocking scene in a beautiful setting, and speaks volumes of the new dimension the latest technology has opened up for photographers.

JUDGES' COMMENTS

AUSTRALIAN GEOGRAPHIC NATURE PHOTOGRAPHER OF THE YEAR 2019

AERIAL PHOTOGRAPHY has traditionally been the preserve of professional photographers with deep pockets, or at least those in the employ of cashed-up clients who can hire an aircraft and its pilot for hours of airtime. In recent times, however, the rapid evolution of drone technology and the increasing affordability of these flying camera systems has put a bird's-eye view within the reach of enthusiastic amateurs, as well as the pros. As a result, images taken from a drone's perspective are appearing more frequently in our annual photo competition and this year, for the first time, it's a drone shot that has taken out the top prize.

Mat Beetson's poignant shot of a dead fin whale would have been hard to capture in any other way than from this lofty vantage point, and his winning image artfully demonstrates the advantages of drone photography. Mat's a professional photographer from Broome in Western Australia who entered the competition for the first time this year. His photo is a stunning example of right place, right time because he and a mate were visiting the Albany region of WA to shoot landscapes when they heard news that a whale had beached nearby. By the time Mat had arrived on the scene and set up his cameras, numerous sharks, which had enjoyed an easy feed earlier in the day, had moved on and now there was just one lone shark. Mat tried to identify the species with members of the Organisation for the Rescue and Research of Cetaceans in Australia (ORRCA), who were also present. They couldn't positively do so but agreed it was either a great white or a bronze whaler. "The 23m whale had beached itself the day before," says Mat. "The ORRCA people said it was highly unusual for a fin whale to beach in this region and the creature showed signs of a desperate life-and-death struggle." Mat waded into the water to photograph the animal from sea level but eventually put up his drone despite windy conditions that might have led to the loss of his gear. "It's all about perspective," he says. "From the shoreline I couldn't convey an idea of the size of the whale, but from the drone you can see scale and signs of the struggle, plus the relative size of the shark. It tells the story of two animals and their behaviours. We don't understand why the whale has done this but we understand clearly the behaviour of the shark," says Mat. "It's a powerful story of the cycle of life for those marine creatures."

Mat's fellow photographers who have been successful this year have that perfect combination of being at ease with the technological aspects of photography and a creative imagination that's able to see the potential in a scene and capture it in a way that then tells a compelling story.

We're sure you'll enjoy the rest of the category winners and runners-up as shown on the following pages. If you can, head to one of the magnificent exhibitions in Adelaide, Sydney and on tour throughout the year to see all the shortlisted photos displayed in glorious large-format prints.

Congratulations to all the winning photographers and all those whose images have been chosen for exhibition.

Visit the Australian Geographic Nature Photographer of the Year exhibition at the South Australian Museum, Adelaide, or at the Powerhouse Museum, Sydney. See page 73 for dates.

JUNIOR

Winner

1 IN THE DARK

Floyd Mallon, New South Wales. Age 17

This night was the most amazing display of lightning that I have ever seen, with constant flashes of lightning lasting hours. For the composition, I decided to focus on a man standing at the edge of the water with an umbrella to add a sense of scale to the image.

Fingal Bay, New South Wales
Canon EOS 5D Mk III, Canon 17–40mm f4 L, 15, f/4, ISO 200, tripod

Runner-up

2 UNDER THE SPIKES

Isaac Wilson, South Australia. Age 10

SHORT-BEAKED ECHIDNA, *TACHYGLOSSUS ACULEATUS*

On the way back from the Murray River we saw this echidna crossing the road. It hid its face and I knew it wasn't coming out, so I decided to take a close-up. That was the best shot I took.

Near Blanchetown, South Australia
Nikon Coolpix B700, 4.3–258mm, 1/100, f/3.3, ISO 100, handheld

Competition partners and sponsors

Principal Sponsor · Presenting Partner · Producer · Exhibition Partners · Production Partner



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5

PORTFOLIO PRIZE

CHARLES DAVIS, NEW SOUTH WALES

A great representation of iconic Australian animals in their habitat. This photographer really knows animals and where to find them. There is a genuine ability to intimately document species in their habitat, and a demonstration of tenacity and preparedness to endure challenging conditions in search of the right shot.

JUDGES' COMMENTS









1 | QUOLL REFLECTIONS

Eastern quoll, *Dasyurus viverrinus*
Status: Endangered
Mt Field National Park, Tasmania

2 | MOUNTAIN ECHIDNA

Short-beaked echidna,
Tachyglossus aculeatus
Kosciuszko National Park,
New South Wales

3 | LIFE IN THE ESKY

Eastern grey kangaroo, *Macropus giganteus*
Kosciuszko National Park,
New South Wales

4 | GLIDERS' HOME

Sugar glider, *Petaurus breviceps*
Cooma, New South Wales

5 | BIG STEP, LITTLE STEP

Common wombat, *Vombatus ursinus*
Kosciuszko National Park,
New South Wales

6 | CRADLE MOUNTAIN POSSUM

Common brushtail possum, *Trichosurus vulpecula*
Cradle Mountain, Tasmania

1





THREATENED SPECIES

2





3 4

Threatened Species

Winner

1
CURIOUS ENCOUNTER

Etienne Littlefair, Northern Territory

MERTENS' WATER MONITOR, *VARANUS MERTENSI*

STATUS: ENDANGERED

Mertens' water monitors are highly inquisitive. This extremely bold specimen ostentatiously approached me to investigate the good-looking lizard in my dome port while I observed another nearby pair engaged in courtship – sadly for him he was staring at his own reflection, not his dream mate.

Adelaide River, Northern Territory

Olympus OMD EM-1 Mk II, Olympus 8mm f/1.8, 1/125, f/11, ISO 64, two Sea & Sea YS-D2 strobes, manual flash output, Nauticam underwater housing, handheld

Runner-up

2
JUST HANGING ON

Neil Edwards, South Australia

GREY-HEADED FLYING-FOX, *PTEROPUS POLIOCEPHALUS*

STATUS: VULNERABLE

On extremely hot evenings grey-headed flying-foxes will dip their bellies into the river so they can lick their wet fur for a drink. This female still carrying her young misjudged her approach and nearly dropped the baby on impact with the river, but somehow it just managed to hang on.

River Torrens, Adelaide, South Australia

Canon 7D Mk II, Canon 100–400mm f/4.5–5.6 L IS USM and Canon Extender EF 1.4X III, 1/1600, f/8, ISO 1600, handheld

Animal Portrait

Winner

3
DECORATOR CRAB

Ross Gudgeon, Western Australia

DECORATOR CRAB, *ACHAEUS SPINOSUS*

Typically, decorator crabs attach pieces of sponge and seaweed to themselves to camouflage and hide from predators (which makes them very poor photographic subjects). However, *Achaeus spinosus* attaches stinging hydroids to itself to ward off potential predators (making it a very attractive subject for photography).

Lembeh Strait, North East Sulawesi, Indonesia

Canon EOS 7D Mk II, Canon EF 100mm, f/2.8 macro USM, 1/250, f/16, ISO 200, INON Z240 strobe with Retra Pro light shaping device, handheld

Runner-up

4
BRIDE IN THE BATH

Melissa Christi, Queensland

TERMITE, UNIDENTIFIED SPECIES

Storms finally broke the dry grip of drought, creating perfect conditions for termite nuptial flights. Making the most of their small window of time, some were lucky, but others were not – like this termite alate. Entranced by the reflective surface, it was trapped by the pond. Serenely beautiful in death.

Mount Perry, Queensland

Nikon D610, Tamron 90mm, 1/125, f/5.6, ISO 250, handheld







Our Impact

Winner **Previous page**

THE WATERING HOLE

Melissa Williams-Brown, South Australia

The Menindee Lakes were deliberately drained in 2016–17 and New South Wales has experienced a lengthy drought. Animals and birds desperately seek food and water and there is very little left due to these human-made and natural events. Lake Cawndilla is now just a drying lakebed scattered with the remains of our native animals.

Cawndilla Creek, Menindee, New South Wales
DJI Phantom 3 Advanced, 20mm, 1/640, f/2.8, ISO 200, ND4 filter

Runner-up **Above**

END OF THE LINE

David Stowe, New South Wales

EASTERN QUOLL, *DASYURUS VIVERRINUS*

Country roads + speed × darkness = the end of the line. And not only for this poor eastern quoll, but for so many other native mammals across our country. In places like Bruny Island, more needs to be done to limit drivers' speed at night. Too many animals lose their lives every night, not only to speed, but carelessness, and, even more sadly, wanton cruelty.

Bruny Island, Tasmania
Canon 5D Mk IV, EF 16–35mm f/4 L IS, 1/100, f/8, ISO 640, Canon 600RT-EX flash (off camera), additional fill light with Wolf Eyes torch, handheld

Botanical **Opposite right**

Winner

1 THE GHOST OF THE FOREST

Marcia Riederer, Victoria

GHOST FUNGUS, *OMPHALOTUS NIDIFORMIS*

The elusive ghost mushroom show starts after dark, when the green light of its bioluminescence glows across the pine forest on the Bellarine Peninsula. It seems like magic but the glowing works to attract insects that then help disperse the spores and spread the mushroom.

Ocean Grove, Victoria
Canon 5D Mk IV, Samyang 14mm, 30, f/2.8, ISO 3200, Manfrotto tripod

Runner-up

2 PANDANI AT LAKE OBERON

Jarrod Castaing, New South Wales

PANDANI, *RICHEA PANDANIFOLIA*

Found only in Tasmania, wild tropical-like pandani are illuminated at sunrise. They're set against the stunning backdrop of Lake Oberon and Mt Pegasus, along the rugged Western Arthur Range, in Tasmania's south-west wilderness.

Western Arthurs, Southwest National Park, Tasmania
Canon 5D Mk IV, Canon 16–35mm f/2.8 L 16mm, 1/60, f/11, ISO 200, Feisol CT-3441 tripod



1

BOTANICAL



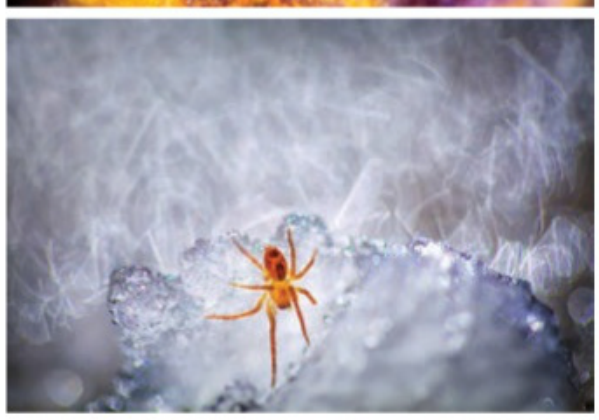
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SEE THIS YEAR'S BEST NATURE PHOTOS

DON'T MISS the stunning Australian Geographic Nature Photographer of the Year exhibitions at the South Australian Museum, Adelaide, from Friday 16 August to Sunday 10 November 2019 and at the Powerhouse Museum in Sydney from Friday 16 August until Sunday 20 October 2019.



1



2



3



4

Animal Habitat

Winner

1
SMALL BUT MIGHTY

Richard Smith, United Kingdom

COMMENSAL AMPHIPOD LIVING IN SOLITARY ASCIDIAN

I was searching for miniature pygmy seahorses on the reefs of West Papua when I happened across this tiny amphipod crustacean. Just 0.5–1cm long, this male is sitting at the mouth of the sea squirt to guard the females and young within. According to an amphipod expert, this is likely a new species.

Raja Ampat, West Papua, Indonesia

Nikon D800, Nikkor 105mm macro, 1/125, f/14, ISO 100, twin INON Z240 strobes, Subal underwater housing, handheld

Runner-up

2
SPIDER ON ICE

Raoul Slater, Queensland

UNIDENTIFIED SPECIES

An overnight blizzard had knocked a myrtle tree down onto the path of the Enchanted Walk next to Cradle Mountain Lodge. I was out in the brilliant sunshine the next morning looking for subjects for my macro lens and came across this tiny spider crossing a patch of snow.

Enchanted Walk, Cradle Valley, Tasmania

Canon 5D Mk II, Canon 100mm f/2.8 L macro, 1/4000, f/3.2, ISO 400, handheld

Animal Behaviour

Winner

3
THE HEAT RUN

Scott Portelli, New South Wales

HUMPBACK WHALES, *MEGAPTERA NOVAEANGLIAE*
DOLPHINS, UNIDENTIFIED SPECIES

The heat run is the ultimate wildlife encounter – multiple whales competing for a female. The chase can last for hours or even days and males can display bubble netting, open-mouth gulping, physical contact, loud acoustic sounds, and breaching. Even after 16 years documenting humpback behaviour in the region, it's still truly heart-thumping and adrenaline-pumping action.

Tonga, South Pacific

Canon 1DX Mk II, Canon 8–15mm fisheye, 1/320, f/8, ISO 200

Runner-up

4
EVIL COUSIN

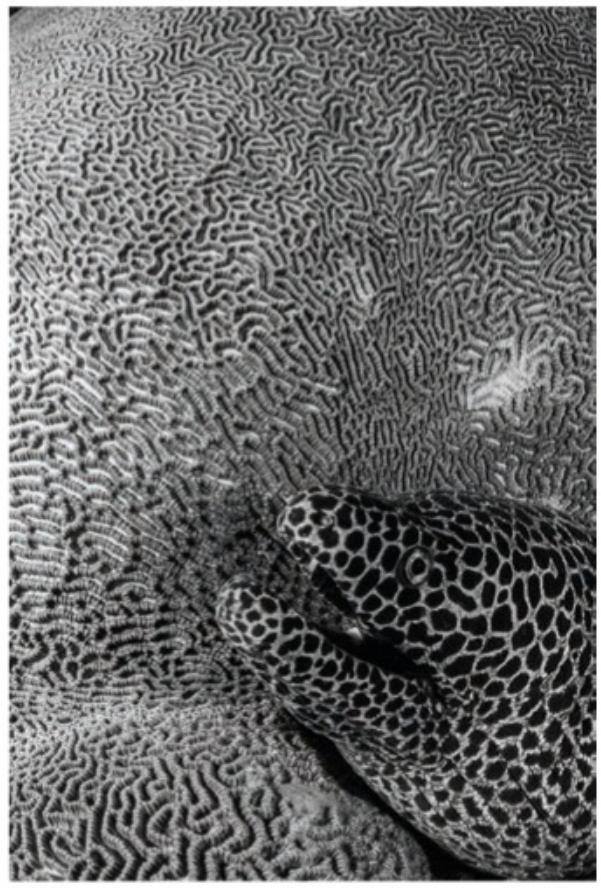
Pete McGee, New South Wales

CRESTED HORN SHARK, *HETERODONTUS GALEATUS*

A crested horn shark feeds on the egg case of the related Port Jackson shark. Each spring Port Jackson sharks gather on shallow reefs to breed and hide up to 10 eggs. Crested horn sharks make the most of the opportunity, searching the rocky crevices for an easy meal.

Cabbage Tree Bay Aquatic Reserve, Manly, New South Wales

Sony NEX7 (mirrorless), Sony 10–18mm, 1/160, f/8, ISO 200, INON strobes, Nauticam underwater housing, handheld



5



6



7



8

Monochrome

Winner

5
TEXTURE

Tracey Jennings,
United Kingdom/Malaysia

HONEYCOMB MORAY EEL, *GYMNOTHORAX FAVAGINEUS*
MAZE CORAL, *LEPTORIA* SP.

I came across this amazing juxtaposition of a honeycomb moray eel and a textured brain coral. It screamed monochrome to me, but one of the significant disadvantages of shooting under water is that you cannot just change your lens to suit the subject. Still, I slowly moved as close to the eel as possible, increased the depth of field, and adjusted my strobes to light up the coral and the eel.

Banda Sea
Nikon D850, Nikonos 13mm RS, 1/200, f/16, ISO 400, Seacam housing, Ikelite 161s strobe

Runner-up

6
KING PAIR CONVERSATION

Andrew Peacock, Queensland

KING PENGUIN, *APTENODYTES PATAGONICUS*

An enormous king penguin colony is overwhelming to all of one's senses. Photographically, it pays to sit and watch for a while to find moments of penguin interaction. Flipping the frame upside down and black-and-white processing allows for a different and creative interpretation of a common scene.

Salisbury Plain, South Georgia Island
Canon EOS 7D Mk II, EF 100–400mm f/4.5–5.6 L IS II USM, 1/800, f/10, ISO 400, handheld

Landscape

Winner

7
BARRON FALLS

Neil Pritchard, Queensland

When Barron Falls (Din Din) is in flood, the usually tranquil scene is transformed into a tumultuous cataract as huge volumes of water make their way to the coastal plain below. The sheer violence of this display, coupled with the deafening roar, makes it an unforgettable experience.

Barron Falls, Kuranda, Queensland
Pentax X-5, 28.3mm, 1/320, f/5, ISO 100, handheld

Runner-up

8
THROUGH THE CURTAIN

Nick Monk, Tasmania

A small waterfall curtains the rainforest of the Great Western Tiers in the Tasmanian Wilderness World Heritage Area.

Great Western Tiers World Heritage Area, Tasmania
Nikon D800, Nikon 16–35mm f/4, 6, f/16, ISO 100, polarising filter, tripod





Seeing the good for the trees

The future of Australia's fast-disappearing forests lies in the hands of our farmers.

Story by **Karen McGhee**

Illustration by **Noma Bar**



"It's an absolute crisis...a source of national shame!" Professor Chris Dickman says in frustration as he leans across his desk at one of Australia's oldest scientific institutions, the School of Life and Environmental Sciences at Sydney University.

Chris is an old-school academic – highly esteemed, with a worldwide reputation in his area of expertise built during a career that's spanned more than three decades. He's very much a man of science who prefers to air his opinions via peer-reviewed research published in highbrow journals.

But the softly spoken, usually mild-mannered, world-leading ecological scientist is angry and, in fact, deeply saddened that parts of Australia have been losing native forests and woodlands at extraordinary rates. Clearly, Chris says, we haven't learnt from past failures to protect our forests, and the potential consequences for Australia are huge.

IT'S NOT AS IF MODERN Australia ever had a lot of trees to lose in the first place. The continent was once covered with forests but that was in the distant geological past. Tree coverage has slowly been receding naturally during the past 5 million years as the climate in this part of the world has dried. By the time of the first European colonisation here, little more than two centuries ago, mainland Australia was mostly desert and arid habitats with only an estimated 30 per cent covered by forests and woodlands.

Today, that's been almost halved, due to the broadscale clearing of trees partly to make way for urban and industrial development, but mostly for agriculture. That we've lost almost half our forest and woodlands in just two centuries is a confronting statistic, but it's largely a historic legacy. Much of the clearing occurred through the 19th century and first half of the 20th, when environmental considerations came second to putting food on the table. It was when our European forebears didn't know any better; before we discovered that most species living in Australia's forests occur nowhere else on the planet; before science showed that healthy forests protect soils and waterways, reaping multiple economic, environmental and social benefits; and it was well before the realisation that trees are an outstanding place to safely lock away carbon from the atmosphere, where it's wreaking havoc with the planet's climate.

And yet, in recent years, deforestation has been proceeding in some parts of Australia at rates claimed to be among the highest on the planet. It prompted Chris and more than 300 of his colleagues across the nation to release a joint declaration in March through the Ecological Society of Australia calling for stronger laws that would restrict the clearing of stands of native trees.

Western Queensland and north-western NSW are the main epicentres of Australia's deforestation activity, most of which is to make way for pastures to run livestock, and, in both states, it's been facilitated by changes in legislation (see page 83).

The consequences of clearing forests and woodlands on the level that's been occurring in Queensland and NSW are huge. The most direct effect is a large-scale loss of native flora and fauna. According to a report released late last year by World Wide Fund for Nature (WWF), forest clearing kills millions of native animals a year in Australia. The report, on which Chris Dickman collaborated, estimated that 87 million animals, including more than 9 million mammals, would have died in NSW during the 17 years to 2015 due to the clearing of 5180sq.km of native bushland.

In Queensland, the woodland habitat most affected by clearing has been brigalow forest. Brigalow is a type of wattle that grows about 20m tall and forms dense stands. Because pastoralism came to western Queensland much later than to the southern states, these forests were largely intact up until the 1960s. They originally covered an estimated 130,000sq.km of inland and eastern Queensland and north-western NSW but in the past six decades more than 90 per cent of this forest habitat has been cleared.

It's estimated that brigalow forests can support as many as 1000 different plant species and provide niche habitats for a huge variety of specialist animals, including the bridled nailtail wallaby, black-breasted button-quail, northern hairy-nosed wombat, golden-tailed gecko and ornamental snake, all of which are now threatened and, in most cases, locally extinct in many areas where they once occurred. Former brigalow forest animal species that are already totally extinct are the paradise parrot, white-footed rabbit-rat and Darling Downs hopping-mouse.

"Australian flora and fauna are highly endemic, particularly the vegetation, mammals, reptiles and frogs," Chris explains. "If the habitat for these animals is destroyed, they've got nowhere to go. We're the only custodians for most of these [woodland and forest species] and we're driving them on an inexorable path to extinction. There are global, regional and local responsibilities for these habitats and I think much of that is being abdicated at the moment."

Tied in with species' loss are more widely felt impacts, including a suite of local ecological services that disappear with the trees. One is flood mitigation and there's evidence the impact of the floods that hit towns in north Continued page 82

PHOTO CREDITS, THIS PAGE AND PREVIOUS: SHUTTERSTOCK



Clearing of this site in the Brigalow Belt in central QLD in the mid-2000s left nowhere for small animals to hide.

FACT

Thirty-five per cent of Australia's native forest is on land protected for biodiversity conservation.





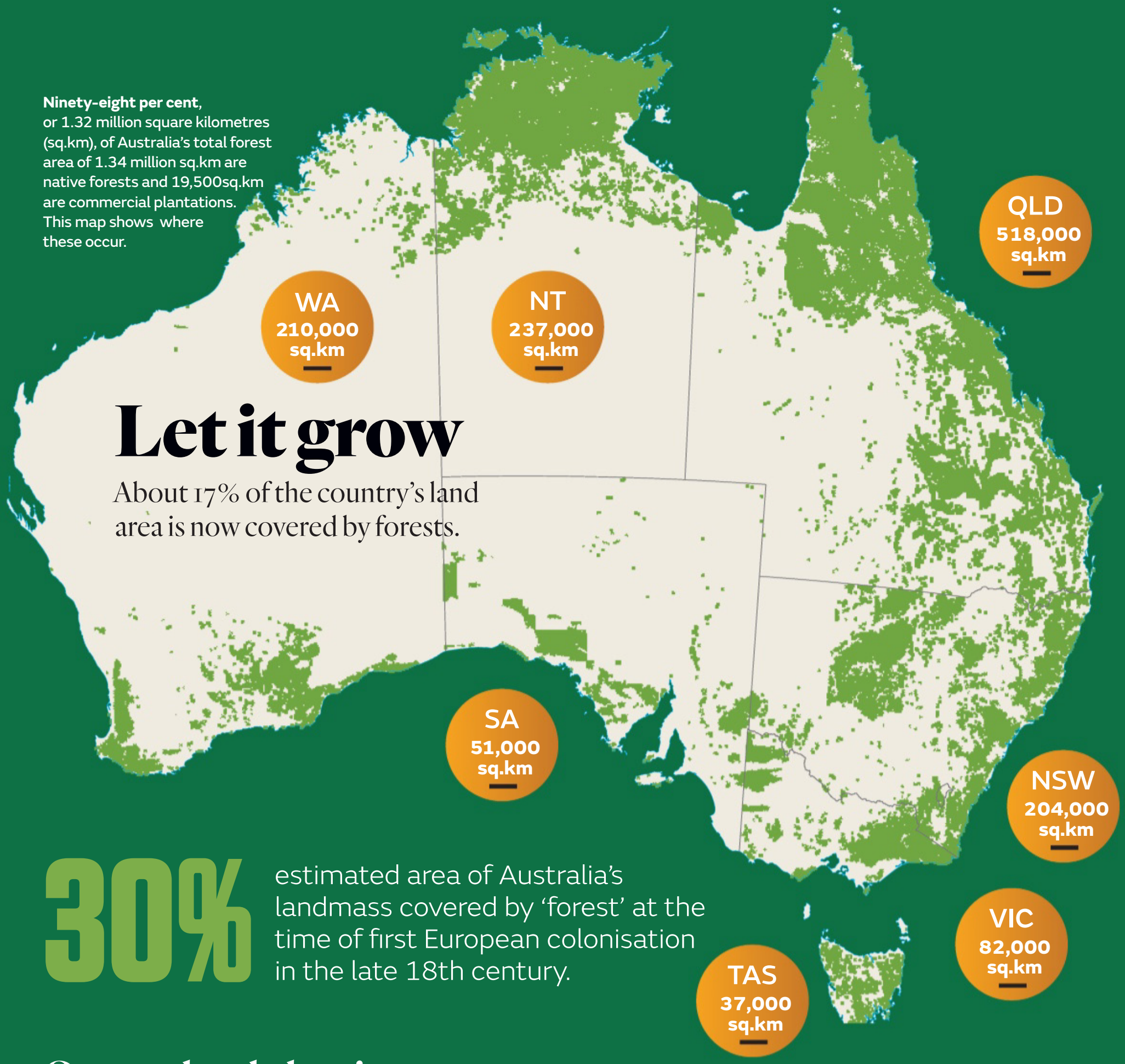
▲ **Two victims of** brigalow forest clearing are the northern hairy-nosed wombat (top), now critically endangered nationally, and the golden-tailed gecko (above).



▲ **Professor Chris Dickman** is one of hundreds of esteemed Australian scientists who have called for the tightening of laws to arrest the country's deforestation crisis.

PHOTO CREDITS, CLOCKWISE FROM TOP: AUSCAPE/CONTRIBUTOR/GETTY; BOBBY TAMAYO, UNIVERSITY OF SYDNEY; BEN NOTTIDGE/ALAMY STOCK PHOTO; MITCH REARDON/GETTY
SCIENTIFIC NAMES, CLOCKWISE FROM BOTTOM LEFT: Strophurus taenicauda; Lasiorhinus krefftii

Ninety-eight per cent, or 1.32 million square kilometres (sq.km), of Australia's total forest area of 1.34 million sq.km are native forests and 19,500sq.km are commercial plantations. This map shows where these occur.



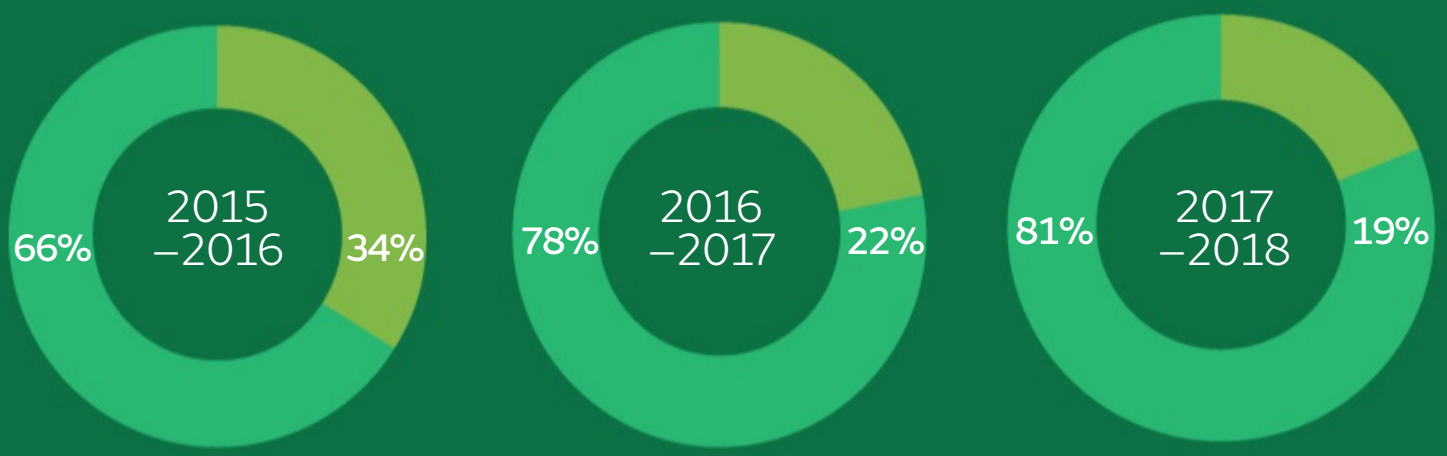
Let it grow

About 17% of the country's land area is now covered by forests.

30% estimated area of Australia's landmass covered by 'forest' at the time of first European colonisation in the late 18th century.

Queensland clearing rates

non-remnant – has regrown after being previously cleared
remnant – never before cleared



FACT

Australia has 3% of the world's forest area on about 5% of the planet's land area.

Forest types in Australia



74% EUCALYPTUS

8% ACACIA

10% other native forests including callitris, casuarina, mangrove

3% RAINFOREST

5% MELALEUCA

Definition: A forest is "an area dominated...by trees having usually a single stem and a mature or potentially mature stand height exceeding 2 metres...[and includes] areas of trees that are sometimes described as woodlands."

FACT

Australia's forests occur mainly where average rainfall is above 500mm/year.

Forest biodiversity



16,836 NATIVE PLANT SPECIES

2486 NATIVE VERTEBRATE SPECIES

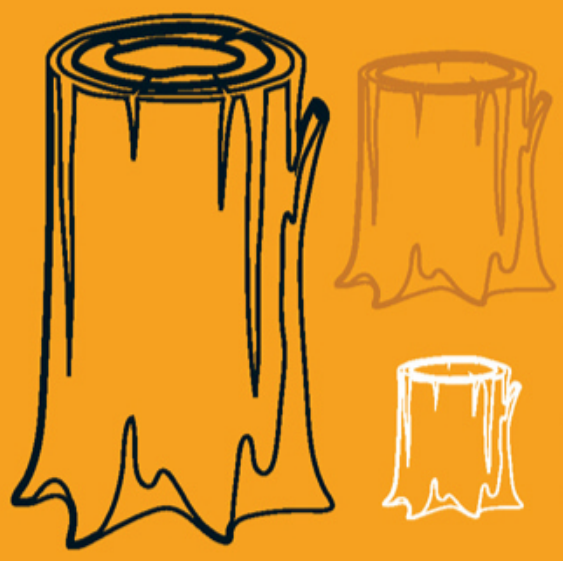
1420 VERTEBRATE SPECIES THREATENED





The leading threat to forest-dwelling native animals is forest loss from clearing for agriculture, urban and industrial development.

Native forest ownership



PRIVATE
880,000sq.km

CONSERVATION
220,000sq.km

PUBLIC
100,000sq.km

Aboriginal estate



700,000sq.km

area of forest over which Aboriginal people and communities have ownership, management or special rights of access. About **69%** of this forest area is in **Queensland** and the **Northern Territory.**

32% of Australia's native forests survive in patches of less than 1000sq.km.

44% of Australia's forests and woodlands cleared since European colonisation.

INFOGRAPHIC BY MIKE ELLOTT AND JASMINE FLETCHER. SOURCE: *AUSTRALIA'S STATE OF THE FORESTS REPORT 2018*



▲ **Like many of** Australia's leading conservationists, Bush Heritage's Dr Rebecca Spindler is increasingly looking to the country's farmers as allies in addressing the nation's deforestation crisis.

Queensland, including Townsville, earlier this year, was worse than it should have been due to forest clearing.

Jelenko Dragisic, general manager of Greening Australia (GA) Queensland, warns it's a sign of what can be expected more and more in the future with climate change. It's imperative, he says, that the resilience of the Australian landscape is safeguarded and reinforced even further by protecting what tree cover we have and restoring what's already been lost. GA has been one of the leading service providers working with landholders and local communities to help deliver large-scale landscape restoration projects across the country through the federal government's 20 million tree project, which is due for completion next year (see *Under the canopy*, AG 147).

In a perverse irony, because it's largely responsible for deforestation in the first place, agriculture suffers when the trees go. "For example, fully functioning woodland has a whole suite of insect species and many can be beneficial in terms of taking out crop pests," Chris explains. Also among these insects are pollinators important for agricultural production.

In another example, Chris says there have been widespread impacts caused by reduced numbers of medium-sized marsupials, such as bettongs and bandicoots, in the dry country in western NSW, due to the removal of woodland habitat to make way for pasture for sheep. "We've got a thin layer of nutrient-impoverished soil across most of Australia and these marsupial species would dig in the topsoil and move it about, tonnes of it every year," he explains. "It would mean it was easier for rainfall to infiltrate and get into the water table, rather than running off and taking the topsoil with it, as now occurs." What these marsupial 'landscape engineers' did was reduce the chance of salination and encourage nutrient cycling. Pockets of organic matter would build up where these animals scratched in the soil, creating little beds of nutrients where plant germination could take place.

Then there are the big picture impacts of large-scale tree loss. Removing large tracts of woodlands or forests affects climate locally as well as further afield. Globally, that occurs through the release of carbon into the atmosphere when the trees are destroyed.

Locally, there can be reduced rainfall when large stands of trees are removed. This is because trees influence local water cycles by taking moisture in through their roots and releasing it through their leaves into the surrounding air. "So you're much more likely to get an increase in the water cycle where you have trees, simply because of that throughput that occurs when rain falls," Chris says. "The dry country is where so much of this devastation is happening. And to most people it's out of sight and out of mind."

WITH SO MUCH FOREST loss having occurred in Australia, saving or rehabilitating every last scrap is now being widely seen as imperative. "We now regard even a small patch of remnant woodland as being incredibly valuable because that's refugia for species that are just trying to find homes and eke out a living in increasingly small pockets of habitat," says Dr Rebecca Spindler, Bush Heritage Australia's executive manager of science and conservation. The original intent of this privately funded, not-for-profit organisation formed in the early 1990s was to buy and protect good-quality native bush on private property. "But we found really quickly that we also needed to buy some of the areas where there should have been high biodiversity and start rebuilding that as well."

To that end, one of the organisation's most extensive and successful projects has involved restoring and reconnecting fragmented woodland habitats between the Stirling Range and Fitzgerald River national parks. It connects with Western Australia's Gondwana Link project, which is aiming to achieve "reconnected country across south-western Australia, from the karri forests of the south-west corner to the woodlands and mallee bordering the Nullarbor Plain, much of which has been cleared for farming". Bush Heritage's work on the Fitz-Stirling mosaic of reserves will restore and reconnect fragmented habitats in this global biodiversity hotspot.

Rebecca explains that the current success of the Bush Heritage project offers hope for rehabilitating many of Australia's already cleared treescapes. "Over the past 12 years we have helped rebuild connectivity in this area and we've seen birds come back that haven't been seen for generations, including malleefowl," she says. "But it's a hell of a lot easier to stop it from going in the first place."

Along with Bush Heritage there are many organisations now working to restore Australia's lost tree coverage, including Landcare Australia, Greening Australia and the Australian Wildlife Conservancy. And there are also many projects at all levels of government, such as Queensland's $500 million Land Restoration Fund, which supports carbon farming through various strategies, including by 'protecting native forest by reducing land clearing'. "We've all got people on the ground working out the solutions [for Australia's declining biodiversity] in the face of increasing threats from all over the place – climate change, invasive species, fire and an absolute barrage of land clearing," Rebecca says.

The most promising projects are working across all forms of land ownership and that, of course, includes farmers, who appear increasingly to be the key to saving and restoring much of Australia's forests and woodlands. "So little native vegetation in NSW remains in a healthy condition, and with 70 per cent of land in NSW privately owned or leased, Continued page 85

PHOTO CREDIT THIS PAGE: ANNETTE RUZICKA; FOLLOWING PAGE: BROOK MITCHELL / STRINGER

Forest clearing: the legal landscape

Legislation protecting Australia's forests comes and goes with changing governments.

LESS THAN HALF OF Australia's remaining native forests are on government-owned land and the concept of legislation to control vegetation clearing on private properties can be unpopular with owners. Nevertheless, laws to control clearing have been introduced since the late 20th century because, as is now well known, natural vegetation has ecological functions that extend well beyond private boundary fences.

Most land clearing in Australia is covered by state laws. In Queensland, it's controlled under the Vegetation Management Act, introduced in 1999 and progressively tightened during the next decade. But in 2012 the newly elected Liberal-National state government began winding back regulations in the Act. It cleared the way for bulldozers to take out large tracts of forests and woodlands that weren't protected in national parks or other forms of reserve in the state.

As a result, tree clearing rose in Queensland by 73 per cent in 2012–13 from the previous year and "by a further 11 per cent from 2012–13 to 2013–14", said the *Australia State of the Environment 2016* report.

Queensland's annual Statewide Landcover and Trees Study shows the destruction continued in 2015–16 when "the total statewide woody vegetation clearing rate was 3950sq.km/year...a 33 per cent increase from the 2014–15 [rate]".

Clearing slowed slightly the following year but then in 2017–18 climbed again to 3920sq.km/year, close to the 2015–16 rate. About a third of land affected is what's known as "remnant vegetation" – virgin bush, never before cleared.

There has, however, been some recent good news in Queensland. In 2015 the newly elected state Labor government foreshadowed a tightening of the Vegetation Management Act and in May last year eventually succeeded in restoring many of the regulations controlling tree clearing that had been removed by the previous government. Scientists are now waiting for confirmation from satellite imagery to show, they hope, that clearing in Queensland has now dropped to a more acceptable rate.

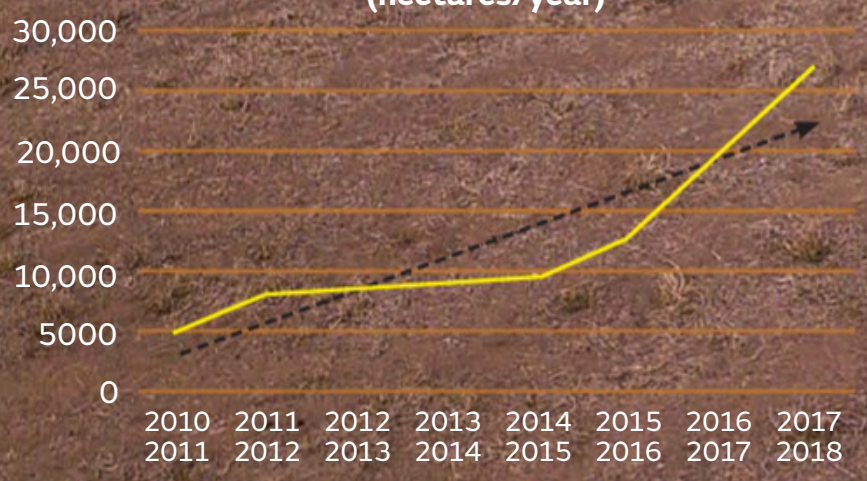
In NSW, recent legislative changes have been responsible too for a level of clearing that has also set alarm bells ringing with ecologists. In 2017 the NSW state Liberal government began a series of "reforms" that led to the repealing of the *Native Vegetation Act 2003*, *Threatened Species Conservation Act 1995*, *Nature Conservation Trust Act 2001*, and parts of the *National Parks and Wildlife Act 1974*. It introduced the *Biodiversity Conservation Act 2017* and made amendments to the *Local Land Services Act 2013*.

In the wake of these changes the Nature Conservation Council (NCC) and WWF compared satellite imagery of the Collarenebri and Moree area in northern NSW from 2016, 2017 and 2018 and found the clearing of forest and woodland "almost tripled in one year following the repeal of the NSW Native Vegetation Act".

Following the claim, the office of the NSW Auditor-General investigated and released a report in June on the impact of the legislative changes. It was damning: "The clearing of native vegetation on rural land is not effectively regulated and managed because the processes in place to support the regulatory framework are weak. There is no evidence-based assurance that clearing of native vegetation is being carried out in accordance with approvals. Responses to incidents of unlawful clearing are slow, with few tangible outcomes. Enforcement action is rarely taken against landholders who unlawfully clear native vegetation."

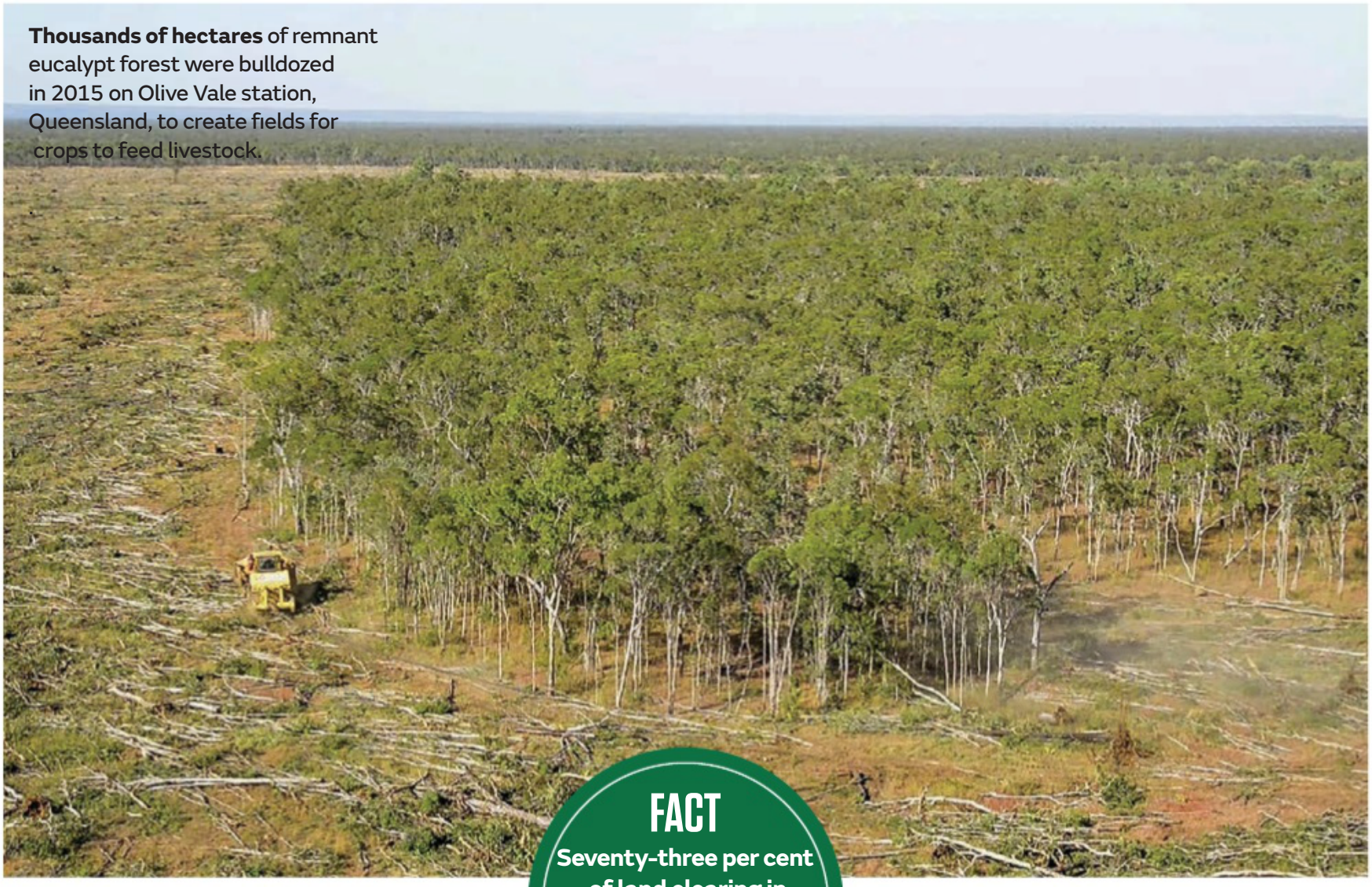
It found the clearing of native vegetation on rural land had more than doubled from 2013–14 to 2016–17 and so too did the extent of unexplained clearing of woody vegetation.

Deforestation in NSW due to agriculture (hectares/year)



Research suggests agricultural land can suffer many negative effects following the removal of large tracts of trees.

Thousands of hectares of remnant eucalypt forest were bulldozed in 2015 on Olive Vale station, Queensland, to create fields for crops to feed livestock.



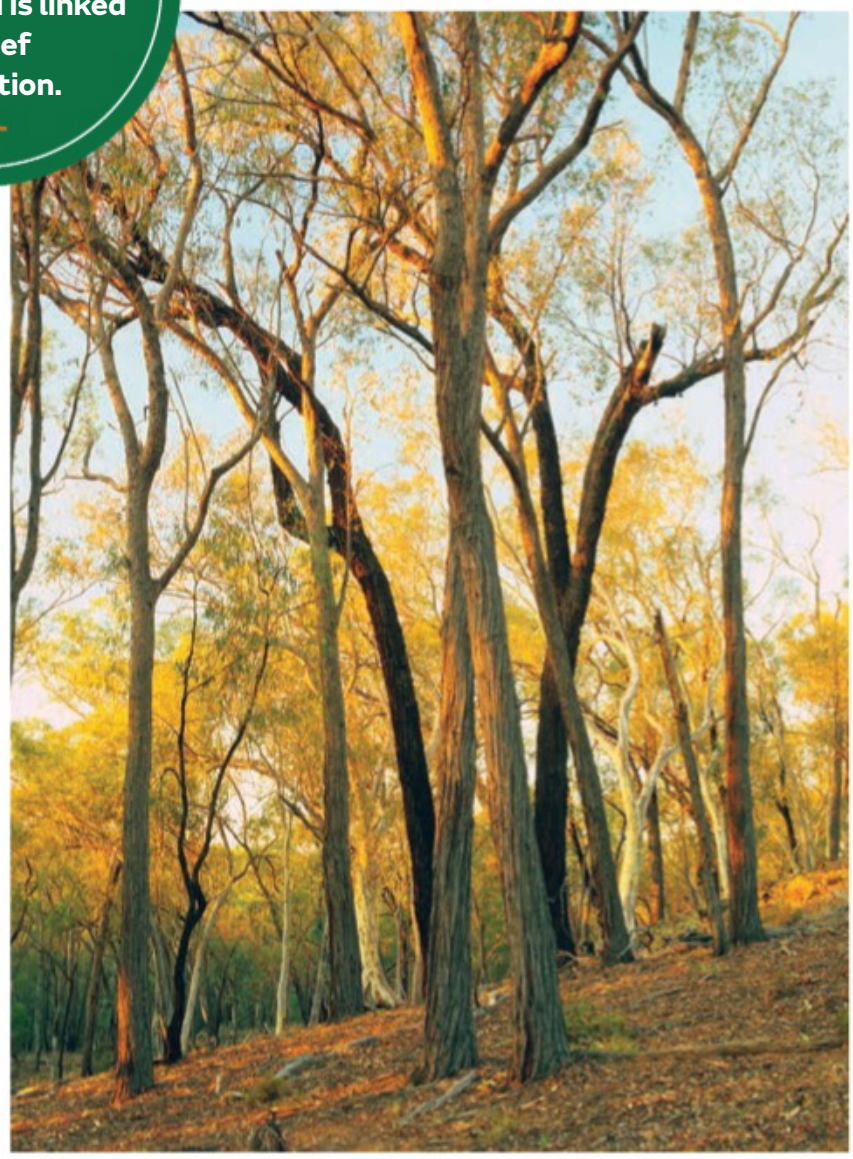
FACT

Seventy-three per cent of land clearing in Queensland is linked to beef production.





▲ **Revegetation (top) has** been one response to land clearing. Medium-sized mammals, such as bettongs (above), are important 'ecological engineers' that disappear along with forests.



▲ **Clearing of box gum** grassy woodlands, like this one in south-eastern Australia, was done on a widespread basis during the 19th and 20th centuries to make way for grazing lifestock.

PHOTO CREDITS, CLOCKWISE FROM TOP: KERRY TRAPNELL / THE WILDERNESS SOCIETY; AUSCAPE/CONTRIBUTOR/GETTY; AUSCAPE/IUG/GETTY; AUSCAPE/CONTRIBUTOR/GETTY
SCIENTIFIC NAME: *Bettongia penicillata*



In short, not cutting down the woodlands made for a better farm.

the responsibility and opportunity to restore our degraded landscapes is in the hands of our farmers," says Kate Smolski, CEO of the NSW-based Nature Conservation Council. "We need legislation that supports landowners to protect and restore forests and bushlands, not encourages them to clear it. In addition to strong laws protecting forests and bushland, landholders should be supported financially to protect and restore areas."

Bush Heritage also sees farmers as critical to addressing Australia's deforestation. "There's already 54 per cent of Australia under grazing…making it a sector that conservationists can't ignore," Rebecca says. She explains she's increasingly coming across farmers looking to find alternative ways of working.

Importantly, they're wanting to source methods that are better suited to local conditions and not based on the higher, more reliable, rainfall and nutrient-rich soils seen in Scotland and England, upon which much of Australian agriculture has been traditionally based.

"We are now looking at more innovative strategies, working with agriculture to find a new way forward so people can have productive, profitable land, working hand in hand with conservation rather than the two sectors being in competition," Rebecca explains.

She stresses that she's not advocating the total de-stocking of Australia. "But I think there really is a middle ground; I think there is a way we can have productive animals on the country but do it in a way that is regenerative and make sure that we're preserving biodiversity values at the same time," she says.

And that's exactly what a landmark pilot study recently run in NSW has found.

THE TITLE OF THE FINAL REPORT into the study released this year leaves little doubt as to what it was all about: *Graziers with better profitability, biodiversity and wellbeing: Exploring the potential for improving environmental, social and economic outcomes in agriculture*. And what it found is good news for Australian forests as well as farmers – that there could be huge gains, including financial, for farmers working their land in a way that supports biodiversity.

Supported by funding from the federal government's National Environmental Science Program, the project looked at grazing in a region that once supported large tracts of box gum grassy woodlands, a type of habitat that has been listed nationally as threatened since 2010. Once widespread throughout south-eastern Australia, less than 8 per cent of the area originally covered by this type of woodland survives: much of it has been cleared for cropping or grazing or modified due to the addition of fertiliser to grow pasture for livestock.

The report compared outcomes for traditional farmers with those who identified as 'regenerative farmers', who'd chosen to retain box gum woodland on their farms and work around it. The idea for the project came initially from Sue Ogilvy, a former physics graduate and IT expert who is undertaking a PhD in environmental-economic accounting at the Fenner School of Environment and Society at the Australian National University. She was intrigued by the fact that although a huge range of quality statistics and facts were collected around farming in Australia, the importance of natural resources to agriculture appeared to have been overlooked.

She joined forces with Mark Gardner who's been an agricultural consultant for more than 20 years in the Dubbo area, working with farmers in the sheep and wheat belt of western NSW. Between them, Mark and Sue enlisted an expert team of ecologists and economists. This included: economists with the NSW Office of Environment and Heritage; CSIRO's Dr Sue McIntyre, the leading expert on Australia's grassy woodlands; the University of Queensland's Dr Thilak Mallawaarachchi, a leading agricultural economist in the Asia-Pacific; and Dr Jacki Schirmer from the University of Canberra who has been running a long-term wellbeing study in regional Australia.

Mark says many farmers want to look after their land for future generations in a way that supports the natural environment. But they often don't know how to do it. "It's the how-tos, the techniques, that require some examination, particularly in light of a more variable climate," Mark explains. "The sorts of questions farmers are asking are: 'Is there another way that we can achieve this desire of looking after our land and potentially handing it on?' And it's just that sort of question that our project has helped in a very small way provide some information for."

Sue agrees it's widely understood that natural resources are a very important part of agricultural production. "But we have not equipped our agricultural economic scientists with the resources to characterise them as a factor of agricultural productivity," she explains. "So we had no statistics to tell us whether farms that had preserved grassy woodlands in good condition were more or less profitable than farms that had cleared them and converted them to exotic pastures."

Particularly telling in the report was this statement: "We conclude that regenerative grazing can be at least as profitable, and at times more profitable, than other methods whilst maintaining and enhancing grassy woodland biodiversity on their properties." In short, not cutting down the woodlands made for a better farm.

Mark says every farmer wants to leave their land in the best condition possible. Not so long ago that would, without question, have meant more introduced pastures and few trees. Now there's a growing movement among farmers that means a farm with native trees, grasses and birds, as well as a profitable business.

"I think revolution is a strong word," Mark says. "But I do think that there's an absolute sea-swell of change in the farming community."

PHOTO CREDIT: SHUTTERSTOCK

Putting Australia on the map

Dutch navigators had accurately charted some two-thirds of the Australian coastline in the 170 years before Captain Cook's arrival in 1770.

STORY BY **NICK BURNINGHAM**





This 25m, 110-tonne replica of the jacht *Duyfken* was launched in 1999 to shed light on the little-known achievements of the original *Duyfken* and its first-ever charting of the Australian coastline in 1606, under the command of Willem Janszoon. Visit the website of the *Duyfken* 1606 Replica Foundation to find out where you can see the ship and how you can sail aboard it.

duyfken.com

Created by English cartographer Emanuel Bowen, this is the earliest known English printed map of Australia. It was published in 1744 using Dutch charts and featuring Dutch placenames. It shows only those sections of coastline so far charted. The mainland east coast would be mapped when Captain Cook arrived in 1770.

TERRA DOS PAPOS by the Spaniards

NEW GUINEA by Jacob le Maire

HOLLANDIA NOVA

TROPIC OF CAPRICORN

Discovered 1644.

Land of Peter Nuyts Discovered 16. Jan.y 1627.

NB. This is the Country seated according to Coll: Purry in the best Climate, in the World.

A COMPLETE MAP OF THE SOUTHERN CONTINENT. Survey'd by Capt Abel Tasman & depicted by ORDER of the East India Company in Holland IN THE Stadt House at Amsterdam

E. Bowen Sculp.

Van Diemens Land Discovred 24 Nov.r 1642

Land first seen

Wits Eylanden



TERRA AUSTRALIS

Discovered A.D. 1644.

It's well known that Dutch mariners visited Australia long before Cook charted the east coast in 1770 for Great Britain.

However, the myth persists that early Dutch knowledge of Australia – which has been home to Aboriginal Australians for tens of thousands of years – was merely the result of clumsy navigation, with Dutch ships accidentally blundering onto the west coast while en route to Indonesia. That certainly wasn't the case. Indeed, European exploration of Australia began with a deliberate voyage by *Duyfken*, a small Dutch ship captained by Willem Janszoon.

In 1606 Janszoon and his crew made the first authenticated European sightings of Australia when they reached the western coast of Cape York Peninsula, in far north Queensland. In the decades that followed, more than 40 Dutch ships sailed to Australia's shores, with their navigators accurately charting much of Australia's northern, western and southern coastlines, including parts of Tasmania. The legacy of these explorers remains with us today in place names such as the Swan River, the Gulf of Carpentaria, Dirk Hartog Island, and Cape Leeuwin.

Duyfken was a small, relatively fast armed ship known as a "jacht" – the term "jacht" comes from the Dutch verb "jagen", meaning to hunt. (During the 17th century, the Dutch invented what we now call yachting using vessels known as "spiel-jachten" (play-jachts), from which the term yacht is derived.) *Duyfken* was tasked by the Dutch East India Company, or Vereenigde Oostidische Compagnie (VOC), to explore what lay beyond the Spice Islands of eastern Indonesia.

On 18 November 1605 Janszoon and his crew, which included ship administrator, or supercargo, Jan Rosengeyn, set off from Bantam, on the Indonesian island of Java. It is often claimed that *Duyfken* then sailed along the southern coast of New Guinea, turned south at Torres Strait, not noticing the strait there, and accidentally charted about 350km of the Cape York Peninsula coast (thinking it was part of New Guinea) before heading back to the Spice Islands.

However, a copy of the chart made by either Janszoon or Rosengeyn, discovered in archives in Vienna in 1933, shows *Duyfken* was sailed due south from False Cape, on the south coast of New Guinea, into the middle of the Arafura Sea. From there, they plotted an exploratory course to a landfall on the western coast of Cape York Peninsula, near what is now known as the Pennefather River. ▸

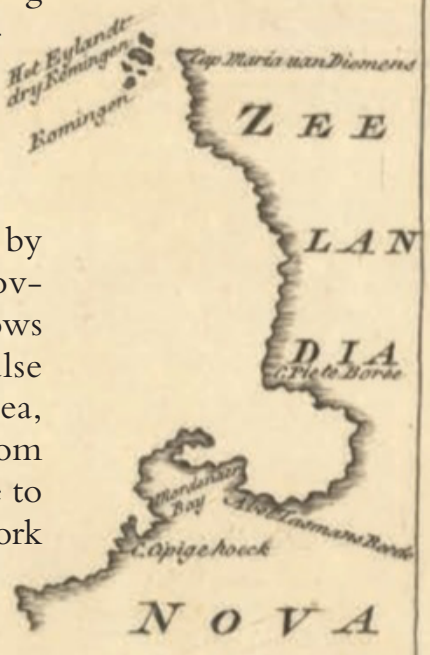
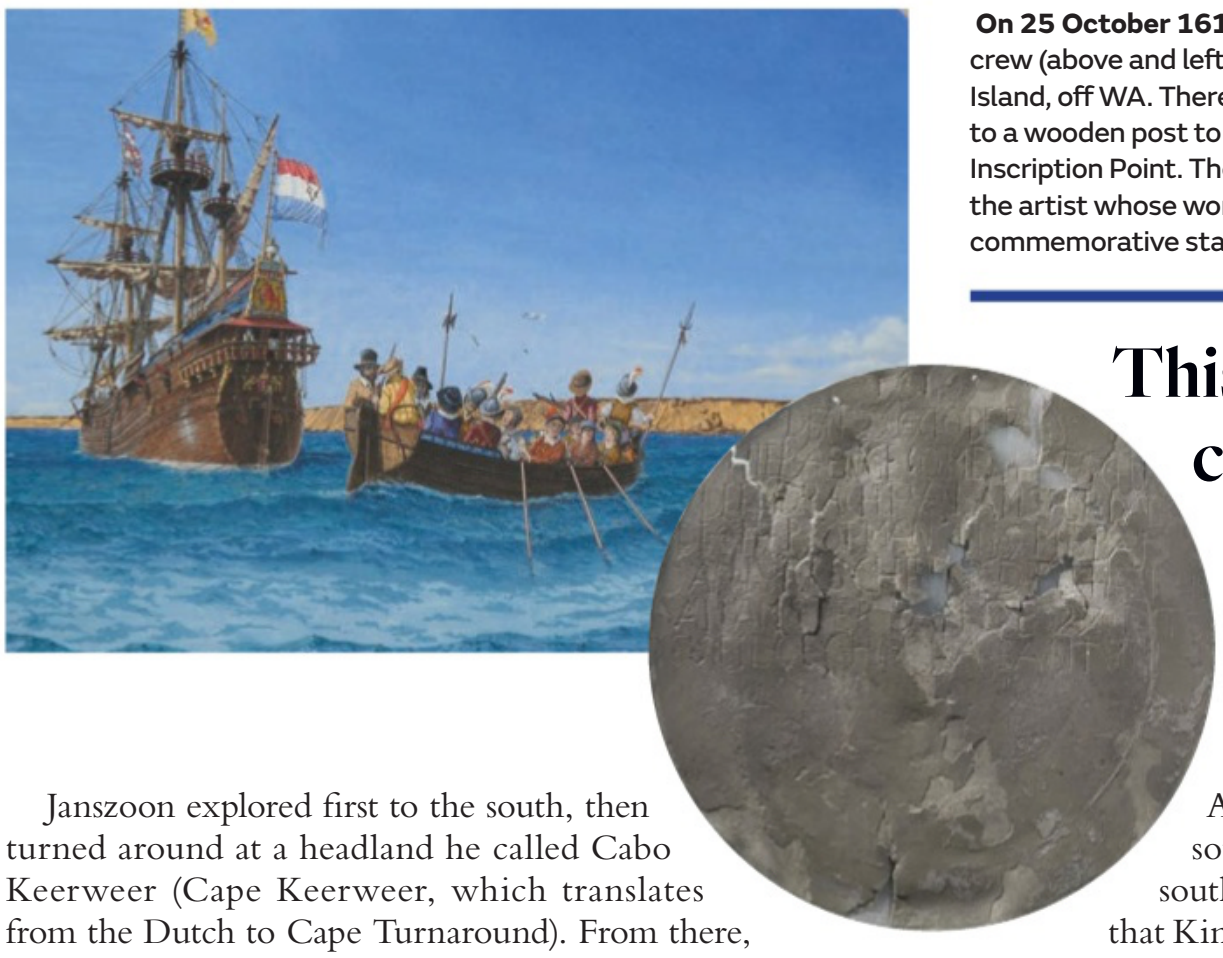


PHOTO CREDIT, PREVIOUS PAGE: SUZANNE LONG / ALAMY STOCK PHOTO.
THIS PAGE: CLASSIC COLLECTION / ALAMY STOCK PHOTO. MAP: PRINCETON UNIVERSITY LIBRARY





On 25 October 1616, Dirk Hartog and members of the *Eendracht*'s crew (above and left) landed on what is today called Dirk Hartog Island, off WA. There they nailed an inscribed pewter plate (below) to a wooden post to mark their presence at the place now known as Inscription Point. These modern paintings are by Adriaan de Jong, the artist whose work appeared on Australia Post's 400th anniversary commemorative stamps in 2016.

This is the first recorded contact between Europeans and Aboriginal people.

Janszoon explored first to the south, then turned around at a headland he called Cabo Keerweer (Cape Keerweer, which translates from the Dutch to Cape Turnaround). From there, he retraced his route north, surveying the coastline all the way to the tip of Cape York. At Port Musgrave, just north of the Pennefather River, Janszoon and his crew encountered a group of Aboriginal people while exploring the mouth of the Wenlock River. This is the first recorded contact between Europeans and Aboriginal people. A crew member of *Duyfken* was fatally speared.

After leaving Cape York, Janszoon sailed north and accurately charted the islands in the Torres Strait. When he reached an impenetrable barrier of reef lying off the New Guinea coast that he called Vuyle Bancken, he headed out to sea and back to the Spice Islands.

The idea that Janszoon thought Cape York part of New Guinea is easily refuted. He, or perhaps Rosengeyn, wrote "Nova Guinea" on the part of their chart showing the Cape York Peninsula. This has been taken to show that he thought it part of the island we call New Guinea. But on what we call New Guinea, he wrote its Portuguese name: Os Papuas. For Janszoon, an educated and expert navigator, the name Nova Guinea referred to the land he had been tasked to find: Terra Australis, the Great South Land or hypothetical southern continent cartographers assumed lay south-east of the Spice Islands. It was speculated that King Solomon's fabled goldmines were here and that, like Guinea in Africa, it would be an abundant source of gold, a "New Guinea".

Janszoon made a detailed chart of the coastline he surveyed that is easily reconcilable with modern-day charts. His voyage marked the beginning of the mapping of Australia by Europeans and was the first of a long list of deliberate, planned voyages ordered by the VOC. However, because Janszoon's account of Cape York Peninsula didn't promise commercial gains, his voyage wasn't immediately followed up with other exploratory expeditions to northern Australia. The next series of Dutch explorations occurred on the coast of Western Australia.

THE SECOND DUTCH ENCOUNTER with Australia occurred a decade later, in October 1616, when Dirk Hartog landed on the island that now bears his name off the Gascoyne coast of WA. Hartog was a skipper of considerable experience before he joined the VOC and set sail for the Indies from the Netherlands in command of *Eendracht* with four other ships. At the time, a new route from the Cape of Good Hope, in South Africa, Continued page 93

PHOTO CREDITS, CLOCKWISE FROM TOP: ADRIAAN DE JONG; ARTOKOLORO QUINT LOX LIMITED / ALAMY STOCK PHOTO; ADRIAAN DE JONG; OPPOSITE: RIJKSMUSEUM

The Dutch East India Company

IN 1602 SEVERAL rival Dutch trading companies were amalgamated into the Dutch East India Company, officially the United East India Company or Vereenigde Oostindische Compagnie (VOC). The VOC was granted a monopoly on Asian trade by the Dutch government to end fierce competition that had forced up the purchase price of spices and glutted the market in Europe.

By the mid-1600s, the VOC boasted some 150 merchant ships and 50,000 employees, a private army of some 10,000 soldiers and trading posts from the Persian Gulf to the East China Sea. It was, in effect, a "state outside the state", with the power to wage war, punish and execute criminals, create new colonies, and strike its own coins. The VOC became a trading colossus; it was the world's first multinational company and the first company with a logo. The VOC's dominance was such that between 1602 and 1796, it sent nearly a million Europeans to work in Asia, its ships making nearly 5000 voyages to various ports in the region. The rest of Europe combined sent out only a fraction of that number of people.

The VOC was a trading company – the return to shareholders was their purpose. They had no interest in taking land beyond that which secured their operations. Colonising Australia was never considered.



Senior merchants of the VOC such as Jacob Mathieusen, painted here with his wife and possibly a slave (left), lived in relative luxury in the VOC's thriving HQ, Batavia, in the 1600s.

Batavia

Batavia was the VOC's headquarters in the East Indies, established in 1619 on the site of the destroyed city of Jayakarta, on the north-west coast of Java, in Indonesia. The name derives from "Batavi", the name of an ancient Germanic tribe then believed to have been the ancestors of the Dutch people. The city's name was changed to Jakarta after Indonesian independence.





Pieter Piertszoon



Gerrit Frederikszoon de Witt



Willem Janszoon

Piertszoon 1636

Colsteerdt 1623

Janszoon 1606

Carstenszoon 1623

Tasman 1644

Tasman 1644

de Witt 1628

Hartog 1616

Pelsaert 1629

Houtman 1619

Pieterszoon Pereboom 1658

Leeuwin 1622

Thijssen, Nuyts 1627



Eendracht



Abel Tasman

Tasman 1642

In the 17th century, more than 40 Dutch expeditions are known to have explored the Australian coast

Here are the key voyages that first mapped the continent of Australia

1606 **Willem Janszoon**
Ship: *Duyfken*
Region: Cape York, Qld. Gulf of Carpentaria

1616 **Dirk Hartog**
Ship: *Eendracht*
Region: Shark Bay to North West Cape, WA.

1619 **Frederick von Houtman and Jacob d'Edel**
Ships: *Amsterdam* and *Dordrecht*
Region: Rottnest Island, Houtman Abrolhos Islands to 26° 20' S, WA.

1622 **Explorer's** name unknown
Ship: *Leeuwin*
Region: Cape Leeuwin, WA.

1623 **Jan Carstenszoon**
Ship: *Pera*
Region: Cape York, Gulf of Carpentaria, Qld.

1623 **Willem Joosten van Colsteerdt**
Ship: *Arnhem*
Region: Gulf of Carpentaria, Arnhem Land, Qld and NT.

1627 **Pieter Nuyts and Francois Thijssen**
Ship: *Gulden Zeepaard*
Region: King George Sound to Ceduna, WA and SA.

1628 **Gerrit Frederikszoon de Witt**
Ship: *Vianen*
Region: Pilbara Coast/ North West Cape, WA.

1629 **Francois Pelsaert and Adriaen Jacobszoon**
Ships: *Batavia* (and ship's boat), and *Sardam*
Region: Houtman Abrolhos to North West Cape, WA.

1636 **Pieter Piertszoon**
Ships: *Klein Amsterdam* and *Wessel*
Region: Melville Island, north coast and Gulf of Carpentaria, NT and Qld.

1642 **Abel Tasman**
Ships: *Heemskerck* and *Zeehaen*
Region: Tasmania, New Zealand

1644 **Abel Tasman**
Ships: *Limmen, Zeemeeuw* and *Bracq*
Region: Gulf of Carpentaria to North West Cape

1658 **Jacob Pieterszoon Pereboom**
Ship: *Elburg*
Region: Cape Lechenault to Geographe Bay



A view of Post Office Island, one of 122 that make up the Abrolhos (*Abri voll olos – keep your eyes open*) Islands, which were charted by Frederik von Houtman in 1619 and subsequently named after him.

to the Indies was being discussed, but had not yet been officially decreed. The so-called Brouwer Route involved sailing due east from the Cape with the strong westerly winds of the Roaring Forties and judging the right position to turn north to head for Sunda Strait, between the Indonesian islands of Java and Sumatera. Previously, Dutch ships had swung through the northern Indian Ocean. The Brouwer Route became the standard from 1617, but because methods of determining longitude at the time were difficult, judging the right position to turn north was questionable. If ships using this new route travelled too far east, they'd sight the coast of WA.

The five ships in Hartog's party became separated during the early phases of their voyage and left the Cape on different dates. Four of them found Sunda Strait without recorded difficulty. Hartog chose to sail further east because he was heading for Sape Strait, east of the Indonesian island of Sumbawa, in order to sail directly to the Spice Islands. As a result, he encountered the western extremity of the Australian coast and landed on Dirk Hartog Island.

On the island, Hartog nailed an inscribed pewter plate to a post as a record of his visit – it is now on display at the Rijksmuseum in Amsterdam, in the Netherlands, and is the oldest known artefact of European exploration in Australia. Hartog sailed north, charting the coastline to North West Cape, in north-western WA. The portion of coast he charted was for some decades known as Eendrachtslandt.

Directly following Hartog's encounter with Australia's west coast there were three more adventitious encounters by VOC ships. In 1618 skipper Haevick Claeszoon van Hillegom and

Methods of determining longitude at the time were difficult.

supercargo Pieter Dirkszoon, unaware of Hartog's discoveries, reached the Pilbara coast, in northern WA, in *Zeewolf* and noted an extensive coastline. In July the same year *Mauritius*, captained by Lenaert Jacobszoon, landed at North West Cape. The ship's supercargo Willem Janszoon, who'd skippered the *Duyfken*, noted human footprints. The following year, Frederick von Houtman, commanding *Amsterdam*, and Jacob d'Edel on *Dordrecht* sighted land somewhere close to Cape Leeuwin, in south-western WA. They followed the WA coast all the way to Eendrachtslandt, noting that it was all one land and discovering the Houtman Abrolhos (Abrolhos Islands).

More intentional and concerted surveys of Australia's west coast took place in the years that followed but it wasn't until 1623, 17 years after the voyage of *Duyfken*, that Dutch ships returned to Cape York. Two jachts, *Aernem* (Arnhem) and *Pera*, commanded by Jan Carstenszoon, were sent to further the exploration carried out by *Duyfken*. They spent two months exploring the southern coast of Papua, which Carstenszoon called de Papues and also, mistakenly, Ceram, the name of a smaller island. Trying to coast eastwards to Torres Strait, they encountered the Vuyle Bancken reefs that had thwarted *Duyfken*'s northward progress.

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The Shipwrecks



The VOC ship *Zuytdorp* was wrecked off the WA coast in 1712. The fate of its crew isn't known, but some believe they set up camps ashore and eventually lived with and married into local Aboriginal families.

OF THE THOUSANDS of VOC ships that sailed to the Indies on the Brouwer Route during nearly two centuries, only four are known to have been wrecked on the Australian coast. The wreckings were horrific and fatal, but the overall safety record is exemplary.

The most famous and gruesome wrecking was the first one: *Batavia*, which was wrecked in 1629 on the Houtman Abrolhos (Abrolhos Islands), about 60km off the coast of Geraldton, in WA. A mutiny among the survivors led to a massacre.

In 1656 *Vergulde Draeck* was wrecked about 180km north of Perth. Seven of the crew managed to sail one of the ship's boats to Batavia, the VOC's headquarters on Java, in Indonesia, and report the wreck.

Several rescue missions were attempted but no survivors were found, even though 75 men were known to have got to shore. In 1712 *Zuytdorp* was sailed or driven by storm onto the cliffs now called Zuytdorp Cliffs near Kalbarri, about 550km north of Perth. The fate of those who got ashore is unknown.

The last wreck, *Zeewijk*, struck a reef in the Houtman Abrolhos in 1727. Its position was known with reasonable accuracy and it was being sailed recklessly towards the coast in the night. The survivors built a small ship from the timbers of the wreck and local mangroves in which they sailed to Batavia.

The Western Australian Maritime Museum displays a dazzling collection of artefacts recovered from the wrecks by archaeologists, plus part of the hull of *Batavia*.

PAINTING: ADRIAAN DE JONG

They disentangled themselves from the reefs and headed south before turning towards Cape York, where they explored a couple of degrees further south than *Duyfken* had, but the chart they produced is notably less accurate than the *Duyfken* chart.

Carstenszoon turned back to the north but the *Aernem's* skipper, Willem Joosten van Colsteerdt, instead decided to head straight back to the Indies. In doing so, he sighted the north-east of what we still call Arnhem Land.

THERE WERE SO MANY contributions to the charting of Australia's coasts, particularly during the 1620s, that we can only mention the more significant among the more than 40 recorded Dutch ships that reached Australia. Outstanding is the voyage of *Gulden Zeepaard*, which was commanded by Pieter Nuyts and skipper François Thijssen. From January to March 1627 they sailed along the southern coast of Australia. What we know about their voyage is almost entirely gleaned from the resulting chart, which shows Australia's southern coast as far east as the Nuyts Archipelago, off what is now Ceduna, in South Australia.

A document written a decade later says their discoveries were accidental, but since it was summer they had no need to be so far east – they could easily have sailed for the western end of Java, where the north-west monsoon was blowing. That more than 1500km of coast could have been surveyed by accident is not really plausible. It was a major addition to geographical knowledge.

Abel Tasman's two voyages of exploration were also notable. They were well-resourced expeditions with ambitious, but not impossible, aims. In 1642 he took the jacht *Heemskerck* and fluyt *Zeehaen* to Mauritius (then a Dutch possession) for provisions and then sailed south into the Roaring Forties in order to make a fast passage to the east. This course brought him to the west coast of Tasmania, which he named Van Diemen's Land after his boss in Batavia. Tasman spent a little more than a week exploring southern Tasmania. His intention was to then sail north, and had he not been forced further east by stormy weather he might have seen much more of Australia, but instead he happened upon New Zealand. Tasman returned to the Indies sailing via Fiji and Tonga around the north of New Guinea. The Australian significance of the voyage lay not so much in what he surveyed as in demonstrating that Australia was not part of a huge, pan-Antarctic southern continent. The approximate extent of the Australian continent was known for the first time.

On his second Australian expedition, Tasman was instructed to explore the southern coast of New Guinea in an effort to find the passage to the Pacific. In the absence of such a strait, he was instructed to explore northern Australia. Like the earlier explorers, he was thwarted by the Vuyle Bancken and didn't investigate the eastern side of Torres Strait, but he did coast

This painting, thought to be of Abel Tasman and his family by Jacob Cuyp, is dated 1637. VOC captain Tasman brought his (second) wife and daughter to live in Batavia.



most of the Gulf of Carpentaria's shores and all the way along northern Australia to North West Cape, showing that it was all one land (even if some of the coast he saw was in fact islands, such as the Tiwi islands).

In 1688 the crew of the English privateering ship *Cygnet*, including navigator William Dampier, landed and did maintenance on their ship on Australia's north-west coast. Back in England, Dampier lobbied for a ship to take on an expedition to the Pacific and the Indies. Eventually, he was given a rotting old fire ship (built to be set on fire and sailed into an enemy fleet) by the Royal Navy. His was an expedition that was seemingly devised to fail, but the discussion of it probably added impetus to a VOC expedition that set out to explore the Indian Ocean and Australia in 1696, led by Willem de Vlamingh. By contrast, it was an impressively well-resourced expedition, using three ships in sound condition and selected for different roles. A principal backer of the expedition was Nicolaes Witsen, mayor of Amsterdam and a polymath scholar. He wanted a voyage of scientific exploration and for specimens to be collected – the kind of expedition that was undertaken by the British and French in the following centuries. Vlamingh was the right man for the job. The charts he and his officers produced show a new level of accuracy. They investigated in detail and collected specimens, including black swans from the river they named Swan River (actually Swarte Swaene Revier and other spellings), which runs through Perth, WA.

The last VOC expedition to Australia was undertaken in 1756, by which time Australia was regularly visited by Macassan fleets from Indonesia. Led by Jean Gonzal, it added little to the knowledge of the continent, two-thirds of which the Dutch had already charted during the previous century. AG

Talking Australia

Listen to a podcast by Master Mariner Gary Wilson on sailing the *Duyfken* replica.
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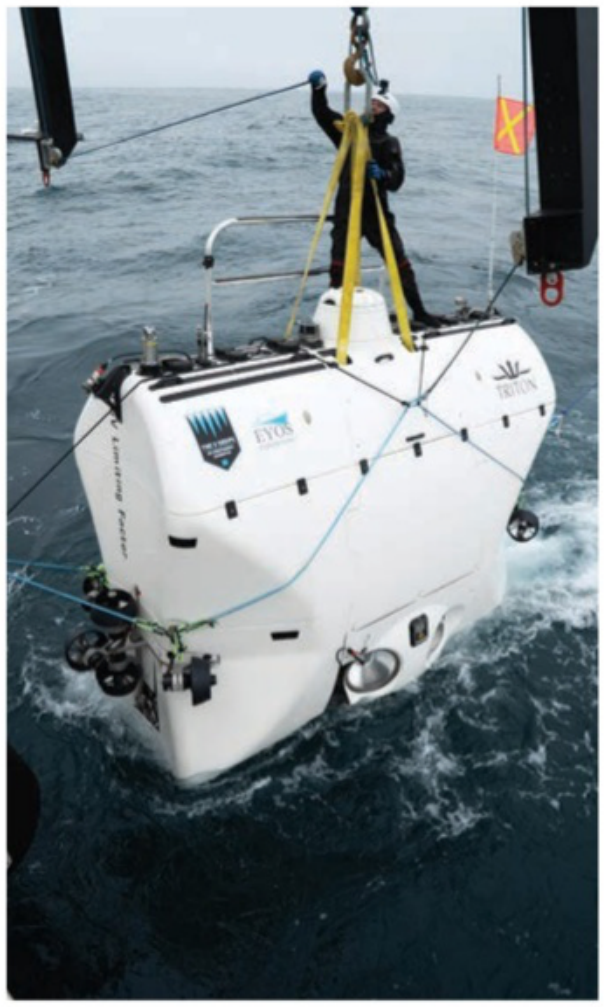
Victor Vescovo (standing) plans the South Sandwich Trench Dive in the Southern Ocean with his team (left to right): Paul Henry Nargeolet (EYOS Expeditions), Captain Stuart Buckle, Patrick Lahey (Triton Submarines), Dr Alan Jamieson (Newcastle University, UK), Dr Heather Stewart (British Geological Survey) and John Ramsay (Triton).

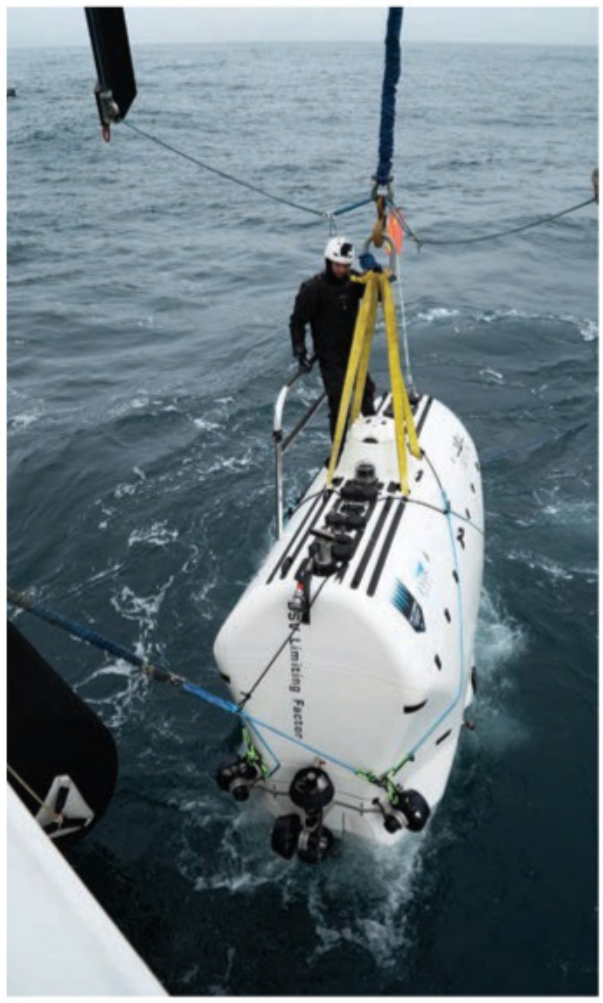
REACHING **DEEP**

Texan explorer and industrialist Victor Vescovo this year dived deeper beneath the ocean than anyone had ever done before. This exclusive insight details the epic journey that took him there.

STORY BY **GLENN SINGLEMAN**







▲ **Launching the *Limiting Factor*** submersible into the wild and frigid Southern Ocean from the stern of DSSV *Pressure Drop* was like a finely choreographed ballet for humans and heavy machinery.

ON 28 APRIL, after three years of intensive preparation, Victor Vescovo finally reached what's now the deepest-known part of the planet: 10,928m under the ocean in the Pacific. Nestled inside a purpose-built deep-submergence vehicle (DSV) called *Limiting Factor*, he dived to the bottom of the deepest ocean trench, reaching 16m further than anyone before. The previous record for a solo dive was 10,908m, set by filmmaker and explorer James Cameron in the *Deepsea Challenger* in 2012.

Victor's record-breaking dive took him deeper than Mt Everest is high, to a cold, lightless, high-pressure place as inaccessible as outer space. It was the fourth successful leg of his Five Deeps Expedition, which was designed to send a human to the very bottom of each of the world's five oceans: the Puerto Rico Trench in the Atlantic, South Sandwich Trench in the Southern Ocean, Java Trench in the Indian Ocean, Challenger Deep in the Pacific and Molloy Deep in the Arctic. The latter was the last left to reach at the time of going to press. A five-part documentary series filmed by Atlantic Productions is due to be shown on the Discovery Channel at the end of this year.

THE DECISION TO embark on the Five Deeps Expedition was made by Victor in 2015 while undertaking The Explorers Grand Slam – climbing the highest mountain on each of the seven continents and skiing to both the north and south poles. After exploring Earth's highest peaks it seemed natural he should seek its lowest depths. But he'd been mulling over the concept well before that and already knew there was a huge problem: he'd need a submersible craft capable of repeated dives to some of Earth's most inhospitable places and such a thing didn't yet exist.

And so Victor partnered with Triton Submarines, based in Florida, to design, build and test the next generation of deep ocean research and adventure vehicles. The result was a submersible that resembled a white-bread sandwich. It was officially dubbed *Triton 36,000/2* (for 36,000-foot capable, with two persons) or *FOD Triton* (Full Ocean Depth). Victor, however, christened it *Limiting Factor* after the name of a spaceship in a book authored by the late science fiction writer Iain M. Banks.

Limiting Factor is a revolutionary craft but to explain why, it's necessary to recap some deep sea history and marine physics.



Dr Glenn Singleman

is an adventurer and three-time AG Society awardee. He was expedition doctor on the Southern Ocean and Mariana Trench legs of the Five Deeps Expedition and was part of James Cameron's *Deepsea Challenger* team.

PHOTO CREDITS, PREVIOUS PAGE: RICHARD VARCOE; THIS PAGE, TOP: GLEN SINGLEMAN; BOTTOM: RICHARD VARCOE; OPPOSITE PAGE, TOP TO BOTTOM: GLENN SINGLEMAN; DR ALAN JAMIESON; RICHARD VARCOE

DEEP DIVE 5
ARCTIC OCEAN
Molloy Deep
Depth: 5670m/18,602ft

Reykjanes Ridge

RMS *Titanic*

DEEP DIVE 4
PACIFIC OCEAN
Challenger & Sirena deeps
Depth: 10,928m/35,853ft
VERIFIED MAY '19

DEEP DIVE 1
ATLANTIC OCEAN
Puerto Rico Trench
Depth: 8376m/27,480ft
VERIFIED DEC '18

Palau/Yap Trench

DEEP DIVE 3
INDIAN OCEAN
Java Trench/Deep
Depth: 7192m/23,596ft
VERIFIED APR '19

Volcano Trench

Primary "Deep" dives
Sonar Operations

Agulhas Fracture Zone

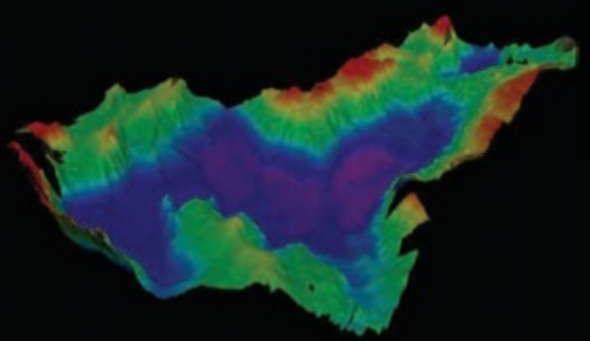
Tonga Trench/Horizon Deep

Diamantina Fracture Zone (DFZ)

Meteor Deep

DEEP DIVE 2
SOUTHERN OCEAN
South Sandwich Trench/Deep
Depth: 7434m/24,389ft
VERIFIED FEB '19

▶ **This 3D sonar image** of the Diamantina Trench, in the eastern section of the DFZ, shows the amazing mapping capabilities of the DSSV *Pressure Drop*.

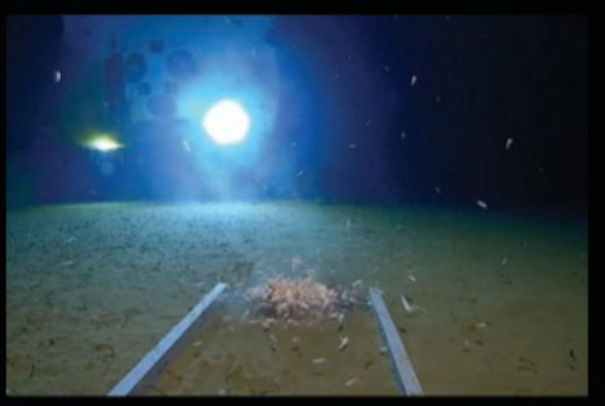


THE **FIVE DEEPS** EXPEDITION

Atlantic • Southern • Indian • Pacific • Arctic

ALTHOUGH THE major adventure aspect of the Five Deeps Expedition is expected to be completed as we go to press, scientists have only just begun to sift through and analyse the huge amount of physical and biological data collected by the project. It has provided an unprecedented opportunity to investigate life and conditions in Earth's most remote habitats. Outcomes from the Five Deeps multidisciplinary science program, led by Dr Alan Jamieson, one of the world's leading deep sea marine ecologists, are expected to continue for years to come.

fivedeeps.com



▶ **Amphipods swarm over** bait at the bottom of the South Sandwich Trench.
▼ **DSSV *Pressure Drop*,** a dedicated scientific research vessel that carries *Limiting Factor*, skirts an iceberg in the Southern Ocean.





Victor performs pre-dive safety checks inside *Limiting Factor* at the beginning of his dive to the bottom of the Southern Ocean.

Extraordinary engineering is therefore required to construct a vehicle that can reach the so-called hadal depths and return in one piece.

EARTH'S DEEP OCEAN trenches have been, and are still being, formed as the planet's tectonic plates crash into each other: one slipping beneath another during a process known as subduction. Trenches are the deep furrows formed at the boundaries between subducting and overriding plates.

The deepest is the Mariana Trench, near Guam in the North Pacific and its deepest part is known as the Challenger Deep, nearly a gobsmacking 11km below the surface. The pressure at this depth, due to the massive weight of the overlying water, is 1100 times that at sea level: about 16,000psi (pounds per square inch) compared with 14.7psi at the surface. It's like the weight of a locomotive engine stacked onto your fingernail. Extraordinary engineering is therefore required to construct a vehicle that can reach the so-called hadal depths and return in one piece.

The first of the three piloted vehicles to visit the Challenger Deep was the bathyscaphe *Trieste*, in 1960, piloted by Swiss engineer Jacques Piccard and US Navy Lieutenant Don Walsh. To the astonishment of the world, the ground-breaking expedition reached 10,911m down – the deepest any vessel, crewed or uncrewed had reached.

Trieste was a large steel sphere attached to a gasoline-filled 'steel balloon'. Because gasoline is lighter than sea water, it provided sufficient lift to bring the bathyscaphe back to the surface. *Trieste* was designed and built by Jacques and his father, Auguste, a fellow explorer, and was bought by the US Navy.

It took five hours to reach its destination and a further three to return to the surface. *Trieste* didn't carry any scientific research equipment or external cameras that could withstand the pressure. When it touched down on the bottom it raised a silt cloud so dense it was impossible to see out. *Trieste* spent less than 30 minutes on the bottom, but proved it could be done.

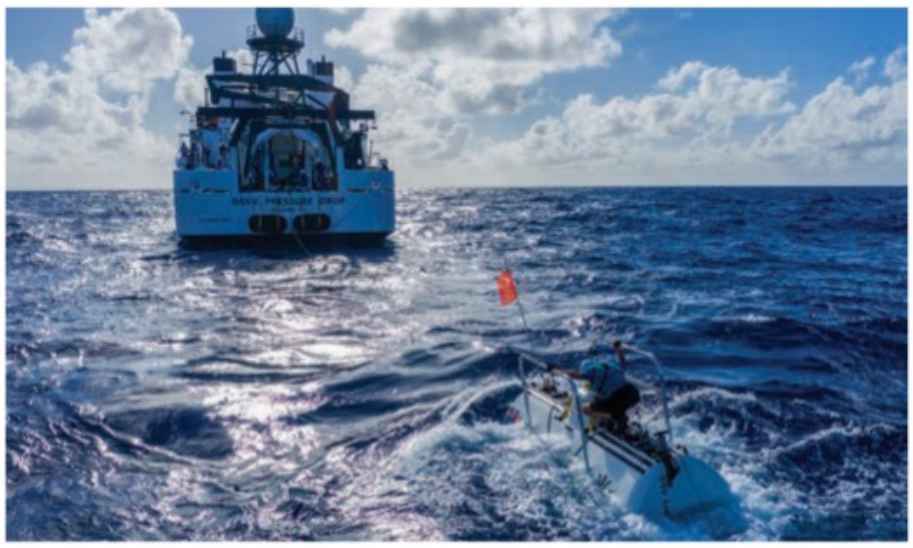
The US Navy persisted with the Nekton program, featuring further *Trieste* dives, for another six months before winding it down. For the next 50 years, deep ocean science was the domain of 'landers' – unpiloted robot vehicles that can collect biological and geological samples and record video.

The next piloted DSV capable of reaching such depths was the James Cameron-designed *Deepsea Challenger*, built by Australian engineer Ron Allum and his team (see *Legend of the deep*, AG 110). Technologically, it was a quantum leap from *Trieste*. The core of both vehicles was a steel sphere to protect the occupant from the crushing pressure, but that's where the similarities ended. Unlike *Trieste*, *Deepsea Challenger* could hold only a single pilot, in somewhat cramped conditions, but the technology was remarkable.

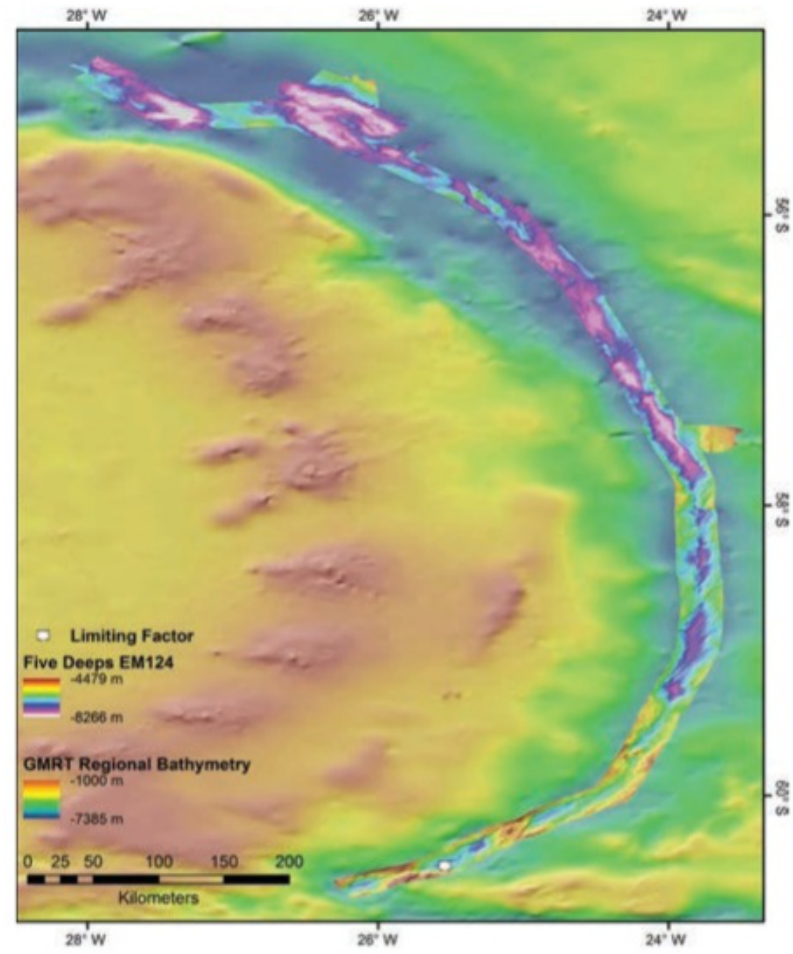
Allum had developed and patented a form of syntactic foam called Isofloat to provide buoyancy for the 12-tonne vehicle. Isofloat contains millions of tiny air-filled glass spheres embedded in an epoxy resin – as strong as steel, yet it still floats. *Deepsea Challenger* was orientated vertically to descend more easily through the water column. And it was decked out in

PHOTO CREDIT: GLENN SINGLEMAN





◀ **Dr Alan Jamieson** holds amphipods retrieved from the science landers that supported *Limiting Factor* in the South Sandwich Trench. A Kongsberg EM124 multibeam sonar image (below) of the trench shows the deepest points highlighted in purple.



◀ **Above the** Mariana Trench in the Pacific Ocean, Tim MacDonald prepares to disconnect *Limiting Factor* after its launch from the stern of DSSV *Pressure Drop*.

lights and 3D cameras so James could record his historic dive in vivid detail.

The vessel was designed to make repeated dives, but, after completing just one mission to the Challenger Deep and suffering some damage, Cameron donated it to the Woods Hole Oceanographic Institution, in Massachusetts in the USA. In 2018 the Australian National Maritime Museum in Sydney hosted a collection of objects from the *Deepsea Challenger* project, which recognised Australia's significant involvement in deep ocean research.

While the technological change from *Trieste* to *Deepsea Challenger* took 52 years, the next leap, to *Limiting Factor*, came in only six. Its pressure sphere is made from titanium, not steel, and it's large enough to seat two people in relative comfort. Designed and manufactured to be fully reusable, it's the only submersible to gain Full Ocean Depth (FOD) commercial certification.

This means it can safely carry passengers, scientists and crew to any part of any ocean. It's why *Limiting Factor* is perfectly suited to reaching the bottom of the world's oceans like no vessel ever before.

A moderately sized mother ship, plus a launch-and-recovery system and support team are needed, but the science and adventure possibilities are endless. The unexplored territory in deep ocean trenches is estimated to be about the size of Australia.

THE FIRST OF THE Five Deeps to be achieved was the Atlantic Ocean's 8376m Puerto Rico Trench, which Victor reached on 20 December last year. This was swiftly followed by the Southern Ocean's 7434m South Sandwich Trench on 3 February 2019. The third was the Indian Ocean's 7192m Java Trench on 10 April this year. The Challenger Deep in the Mariana Trench was the fourth. And the final and fifth record was to be broken as we went to press, when *Limiting Factor* was expected to head to the bottom of the Arctic Ocean's 5670m Molloy Deep.

The Southern Ocean expedition was the most challenging in terms of remoteness and weather. The South Sandwich Trench is about 850km south-east of South Georgia, which is itself 1390km from the Falkland Islands. Most of the South Sandwich has never been sonar-mapped, so the goal was to thoroughly map the trench before diving to its deepest points.

The expedition's mother ship is a 68m ex-US Navy Stalwart class Cold War submarine hunter now called DSSV *Pressure Drop*. Its quiet diesel electric motors permit communication between the surface and *Limiting Factor* by using high-tech underwater acoustic communications systems.

The wild card in any Southern Ocean expedition was always going to be the weather. Compounding already sub-zero air temperatures, the high-speed westerlies of the Screaming Sixties whip up monster swells and a vicious wind-chill.

PHOTO CREDITS: TOP, GLENN SINGLEMAN; BOTTOM; TAMARA STUBBS





Victor is helped out of *Limiting Factor* (left) after completing the Mariana Trench dive – the fourth and deepest of the Five Deeps. Soon after, he's congratulated by Captain Don Walsh (below) who, along with Jacques Piccard in *Trieste,* was the first person to reach the deepest point in the oceans.

Massive icebergs up to 20km across dotted the ocean, while humpback whales breached, chinstrap penguins screeched and albatross lazily swooped around the ship. The crew complement included marine engineers, electronics and communication specialists, scientists, filmmakers, sonar operators, submarine life support engineers, an ice pilot and a doctor (myself).

Launching a submersible into the Southern Ocean is not for the faint-hearted. To be prepared, the team practised the launch-recovery system in the relative safety of Cumberland Inlet on South Georgia.

With practice, a complex manoeuvre involving the ship, the tenders, the cranes, the crew, the communications systems and the film crew was fine-tuned. Mt Paget (2934m) and the other mountains of the Allardyce Range towered over the team as they worked in the calm waters of the inlet. Like most visitors to South Georgia, the crew paid their respects at the grave of the great 20th-century polar explorer Ernest Shackleton near the ruins of the Grytviken whaling station.

The Southern Ocean is home to Earth's highest waves, strongest currents and most powerful winds. The expedition plan was to sonar-map the South Sandwich Trench while waiting for a weather window to dive. As it happened, the weather window came sooner than expected. Almost as soon as the deepest point in the Southern Ocean was mapped, Victor decided to dive.

The launch sequence was repeated flawlessly in open ocean and at 1.15pm on 3 February, *Limiting Factor* was on its way down to the 7433m bottom.

The very cold water created some problems – a large thermocline at 4000m prevented acoustic communications – and the deck crew suffered in the bitter cold. But after a three-hour descent, Victor reached the bottom, becoming the first human to visit the deepest point of the Southern Ocean.

You might think there would only be emptiness and desolation here, but patience and careful observation revealed life-a-plenty to Victor.

YOU MIGHT THINK there would only be emptiness and desolation here, but patience and careful observation revealed life-a-plenty to Victor, as has been the case in the other trenches too. On video, amphipods – a type of crustacean – can be seen darting around *Limiting Factor*, and one of the landers filmed three new species of snailfish. Worldwide more than 9950 species of amphipod have been described and Dr Alan Jamieson, Five Deeps Expedition chief scientist, is confident more were discovered in the South Sandwich Trench.

Alan is concerned about the human pollutants such as PCBs, microplastics and lead that were found among the deep-sea fauna. It's a sobering thought that humanity's rubbish reached the deepest parts of the oceans before humans did.

When Victor returned to the surface, he had to be careful not to come up under an iceberg. Fortunately, communications were re-established when the submersible was above 4000m and he was given the all clear to surface. Like the record-breaking Mariana Trench dive that would follow nearly three months later, the Southern Ocean dive was a spectacular success. AG

FOR TICKETS to the 2019 AGS Gala Awards, where you can hear Victor speak, go to *australiangeographic.com.au/awards*

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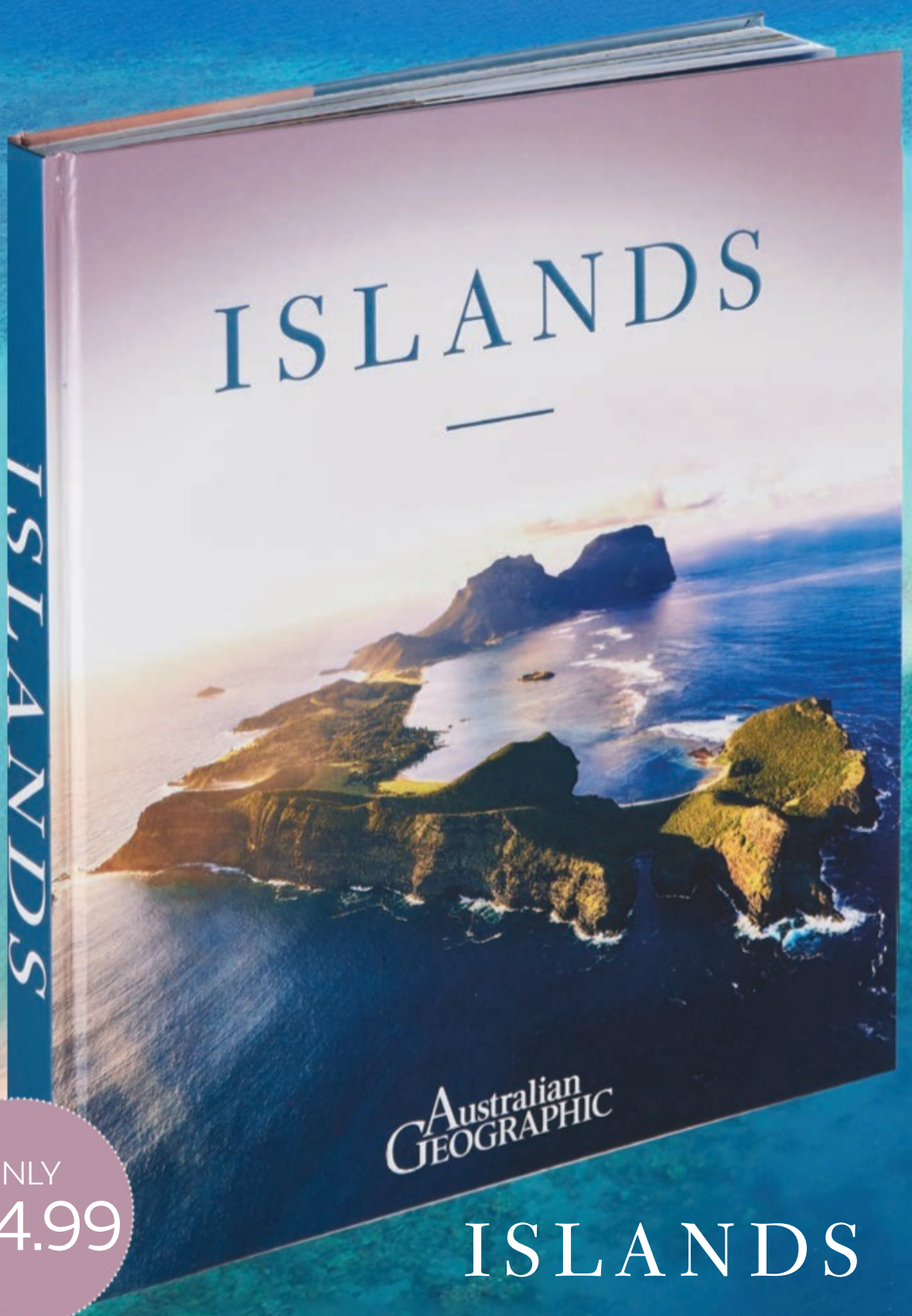
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Truffle-finding canine extraordinaire Barry prepares to go hunting with a group of tourists at L'Air Du Wombat truffle farm along the historic Wool Road in NSW.

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Torres Strait Islands festival

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The Wool Road

PHOTO CREDIT: THOMAS WIELECKI

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Strait talking

The Winds of Zenadth festival is one of Australia's most vibrant celebrations of song, dance, language and history.

STORY AND PHOTOGRAPHY BY **AARON SMITH**

The Purple Spider Dance Team from Erub Island performs a traditional 'rites of passage' dance.





Torres Strait Islander culture is loud and proud. At the Winds of Zenadth Cultural festival on Thursday Island, dancers strut with painted faces, wearing elaborate headgear that ranges from traditional white-feathered dhari headdresses and dark crowns of cassowary feathers to contemporary depictions of constellations, totems, and even boats and planes.

The Torres Strait islands are an archipelago of more than 274 islands lying in the narrow passage of water that separates Queensland's Cape York Peninsula and New Guinea. The sound, colour and movement of their biennial festival vividly illustrates the renaissance of an ancient culture. Named after Zenadth Kes – the Islander name for Torres Strait – the event has been going from strength to strength for 32 years. Its dance teams are well-oiled machines, performing local stories of mythology, astronomy, totems and the four winds of Zenadth in perfect unison to the resonating thump of the long, wooden warup drum. The air is filled with the haunting wail of singers belting out ancient songs in language. (Two Indigenous languages are spoken on Torres Strait islands – Kala Lagaw Ya and Meriam Mir. There are also six dialects of Creole, which blends English with the local language.) The dancing starts early in the morning and goes until late at night.

One of the architects of the festival, the late Ephraim Bani (chief of the Wagadagam clan and a renowned cultural adviser and linguist), once said: "The past must exist, for the present to create the future." The phrase is engraved on a boulevard on the waterfront at Thursday Island (TI), one of Torres Strait's main islands.

Fanning the flames

Ephraim's son Gabriel Bani likens his culture's revival to a fire. "Dad said the wisdom of the Elders is the firewood, and he said his job was to push the wood into the fire and fan the flames," says Gabriel, a cultural adviser and councillor of the Torres Shire Council, which organises the festival. "Now he's gone, that job falls in our lap."



▲ **Aaron Whap from** the Kigu Dance team, from Mabuiag Island, performs the Aeroplane Dance that retells the story of the Japanese bombing raids during WWII.

Torres Strait life changed forever in the early 19th century. European ships began passing through en route from Brisbane and Sydney to Asia (see *Putting Australia on the map*, page 86); the sea cucumber and trochus shell industries arrived; then missionaries, colonisation and the pearling industry swiftly followed. Intermarriages took place and aspects of traditional culture were lost. "Our Torres Strait Islander culture was in serious danger," Gabriel explains. "And that's why Dad and the other Elders put on the first festival in 1987. Their main aim was to revive our culture."

Like much of Aboriginal culture, Torres Strait Islander culture was profoundly affected by colonisation, and later by legislation such as the *Aborigines Protection Act 1909*, which allowed the Protection Board to remove children from their families – a policy that led to the Stolen Generations and fractured many Torres Strait and Aboriginal families. "With the missionaries taking over, all the cultural practices were seen as pagan," Gabriel explains. "They got rid of the traditional meeting places, the sacred places, known as the kwods, and they put curfews on us at night."

A performer from the Wugalgau Kalin Thitui Dance Team from St Pauls community on Moa Island struts her stuff at the Winds of Zenadth Cultural festival on Thursday Island.



Dressed in an elaborate traditional costume, Jehemess Waia focuses intently during a performance with the Mungu Koekaper Dance Team from Saibai Island during the 2018 festival.



Even as late as the 1980s, Islander culture was frowned on by the authorities, recalls Torres Shire Mayor Vonda Malone. "In those early days, we'd only dance at the school on Sundays for tourists, or away down south, like when I performed once at a Melbourne Cup," she says. "But it was shunned at home back then. We weren't allowed to speak Creole at school. We had segregation: 'half-castes' were segregated from 'full-bloods'. So back then it was about our culture surviving, while now it's about it thriving."

Certain places retained culture more easily, Vonda adds. "Because my mum's generation was in that segregation, they weren't able to pass culture down to us, particularly here on TI. We only got to fully embrace our culture when we went back to the outer islands, where I spent the early part of my childhood," she explains. "That was the time we were able to grasp the island ways."

Those ways were wonderful. "I remember at events on the islands they would dance from nine in the morning right through the night. Us kids would sit on woven mats and watch with a hurricane lamp," Vonda says.

Speaking out

Vonda's cousin Fred Gela, another charismatic young leader, is mayor of the Torres Strait Island Regional Council, which oversees the remote outer island communities. He was in Year Seven in 1987 when he performed at that first festival. "The festival ensures our culture not only survives but continues to be handed down from one generation to another," Fred says. "Language, as part of culture, suffered as a result of the DNA [Department of Native Affairs] and the Protection Act. If you spoke your language at that time, it would have an impact on your food rations. So we grew up not being able to speak fluently [in] our mother's tongue, which is Meriam Mir. So for me, when the first festival occurred, it was a big shift in mindset."

The region's languages have been recognised as severely or critically endangered by UNESCO, and so a Regional Language Centre was officially opened as part of the 2018 festival. "Having this centre now, it gives us the ability to learn our mother tongue that was lost as a result of colonialism, as a result of past policies of segregation and assimilation," Fred says.

▼ **Aunty May Passi** from Murray Island watches over a new generation of dancers keeping culture alive.



▼ **Large warup drums** are played on a march by all the region's dance teams through the streets of Thursday Island.



Part of a growing movement that's seen cultural festivals flourish across the far north, the Winds of Zenadth attracted record crowds of more than 5000 in 2018. It has helped champion political change, too.

The 1992 festival saw the raising of the Torres Strait flag for the first time, just weeks before the landmark High Court victory of Torres Strait Islander Eddie Mabo. Community leaders led the 2018 opening march carrying the Uluru Statement from the Heart, the 2017 document calling for a First Nations Voice in the Australian Constitution.

Living traditions

"Our culture is ongoing and that's the beauty about it," Vonda says. "It's always evolving and we're always adapting it." Along with ancient dances, festival performers tell stories of the arrival of the pearling luggers, or of the World War II Japanese air raids on Horn Island.

These spurred almost all the Island men to enlist in the Torres Strait Light Infantry Battalion, the first and only all-Indigenous Australian battalion. Its contemporary equivalent, the Sarpeye Company (Creole for Sharp Eyes), danced at the 2018 festival in full fatigues, machine guns firing in unison.

"Choreographers were always middle-aged or elderly," Fred says. "But now we've got young people coming through, which is great because for our culture to survive, it's essential there's a succession plan that supports our younger generations."

One of those young choreographers is Phillemon Mosby, from the central island of Poruma. Two years ago he began composing new music and dances, working with his community's Elders to revive their dialect of Kulkalgaw Ya. It was the death of his father, lost at sea in 2004 while working on a pilot boat guiding cargo ships through the perilous Straits, that sparked his creative urge.

"It took a very long time for me to get over that," Phillemon recalls. "One night, when I was preparing a meal, I looked out my window and saw the pilot boat come in. That was my moment of letting go and I started writing about my experience. I wanted to express culture and language through the times we are living in today."

The Poruma community dance team performed Phillemon's Pilot Boat Dance at the 2016 festival. His most recent musical composition, *Red Kungaru*, retells a Qantas flight he took early on a winter morning from Adelaide airport. "I was totally fascinated to see outside the window of my flight so many Qantas 747s neatly parked," he says, explaining that the song helps ease jangled nerves of people leaving their Island home by plane for the first time. "We're oral history people: we yarn about stuff, and song and dance is a powerful way for people to tell their stories and pass the message on.

"Our culture is an evolving one. While there are the ancestral dances, which are important to us, we need to connect as Torres Strait Islanders with where we are today, as well. If we're going to be future writers of our songlines, we need to do it now while our Elders are still alive."

Another young Islander reinterpreting his culture is dancer and catwalk model Hans Ahwang, from the island of Moa (called Mua by locals). He graduated from NAISDA Dance College in 2015. "The companies I work with collaborate in making a fusion of dance styles, so in that sense it's contemporary," Hans says. "We might use an Aboriginal movement here then a Torres Strait Islander movement there, so it's all mixed into one."

Hans, whose arms and chest are tattooed with totemic symbols, has performed in the USA twice and even uses traditional moves on catwalks. His skills and discipline come not only from his professional training but from his upbringing: "The Elders used to growl at us in language to do the dance properly – no laughing, no playing around. It was very strict," Hans recalls. "When I go back home to Mua, I growl at our community dance team because it's the way things should be done."

Hans also works with a dance troupe that provides learning kits for schools, and after the teachers and students have had time to digest the material, the troupe



The Saam Karem Era Kodo Mer Dance team, from Murray Island, performs the rarely seen sacred fire dance at the Winds of Zenadth.

Winds of Zenadth

Frequency: biennial **Next held:** 2020

tropicalnorthqueensland.org.au/where-to-go/torres-strait/

visits and performs with the students. They're booked out 12 months in advance. "It's all songs and games and culture and instruments from the Torres Strait," Hans says. "When we come into the school and do the performance, they do it with us. When they sing in language we get teary, it's so emotional for us. They're not [TI] kids, they're all these mixed-race [children] learning our songs and dance."

A recent highlight was performing at Sydney's Loreto Kirribilli School. "One of the richest schools in the country," Hans says. "All the girls were in costume and singing in language. We all got goosebumps."

Unbroken bonds

For Gabriel Bani, culture is about connectivity: "We connect everyone: it's about belonging in this world, to belong somewhere," he says, explaining that culture isn't just dancing and singing, but what's underneath. "[It's] to do with our totemic relationship, our land, the relationship with the constellations, the genealogies, the seasons," he says. "So it's a deep culture but people only see what's on top."

Songs and dances are important, Gabriel says. "They connect you all the way through ancient history and contemporary history, and that's always been a constant thing," he explains. "But the core of our culture is our family kinship structure, and there was a breakdown within those structures, so that's where the real work is now. When you talk about families and kinship structures, then you talk about land: these are the cornerstones of culture – family, land and language."

But, Gabriel adds, values have changed over the years. "Now it's all to do with economic growth and the individual – that's conflicting with traditional practice," he says. "The biggest struggle is to get back to those original core values. But the wheels are turning, and they have been turning for some time, and they are getting movement now; the fire is burning stronger.

"Now at high school graduations, every student says, 'My name is… My totem is… My wind is…' I didn't do that at school. People are now connected to their totemic relationships and people are starting to speak language now. We were never allowed to do that before – imagine the changes 20 years from now. It's like Dad said, life without culture is life without life. Too good."



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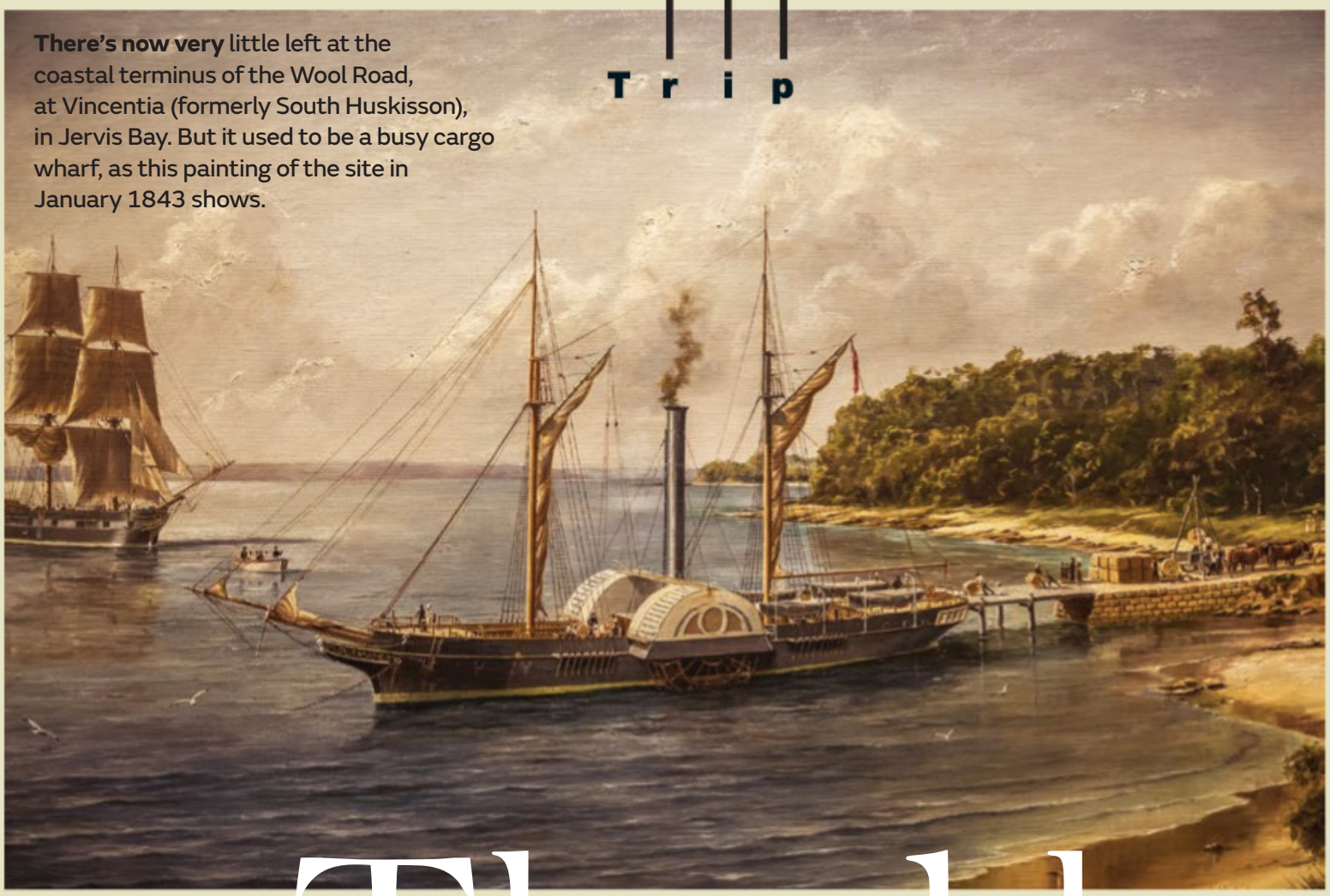
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Road Trip



There's now very little left at the coastal terminus of the Wool Road, at Vincentia (formerly South Huskisson), in Jervis Bay. But it used to be a busy cargo wharf, as this painting of the site in January 1843 shows.

The old Wool Road

From its beginnings as an Aboriginal songline to its heyday as a busy stock route, the Wool Road offers a fascinating journey between Canberra and the coast with plenty of reasons to tarry along its twists and turns.

Story by **Tim the Yowie Man** Photography by **Thomas Wielecki**

Sealed all the way from Canberra to the coast, the Wool Road passes through a range of landscapes, from windswept plains to dense forests.

Next to the Nerriga Old School House Museum is an abandoned sawmill, complete with a number of surrounding workers' cottages that are now included in the museum.

GUM TREES LINE the roadside, their crowns shaking back and forth like giant pom-poms in the stiff southerly, enticing us along this strip of fresh bitumen that slices through a vast swathe of the Southern Tablelands of New South Wales. Unlike the ominous clouds that rush overhead, we're in no hurry.

We're travelling along the Wool Road, a historic 1841 bullock route hacked out of the 'new country' by 70 convicts to cart wool from the prosperous Monaro and Goulburn districts to Jervis Bay for shipping to Sydney and beyond.

Already an hour on the road, however, and the only stock we've spotted are grazing cattle and a few horses galloping along a rickety old fenceline…oh, and a couple of alpacas sheltering in a gully. With no sign of a ram or ewe within cooee, we're starting to think we may have taken a wrong turn.

Thankfully, on the outskirts of Nerriga (population 75, on a good day), a sign swinging in the wind outside a tiny timber cottage, emblazoned with the word "museum", catches our attention. Stepping on the brakes, we pull up in a pall of dust.

We scurry into the cottage that, until 1974, housed the village's only school. Although not as fierce as on the exposed plains, the southerly does a good job of slamming the door shut behind us.

"Aha, the Wool Road," says Josette Allester, a cheery volunteer who greets us with a knowing smile and a nod. She ushers us towards the back wall of the museum to a display of images of the route before and after its 2010 upgrade.

Josette confirms we're definitely on the right road, "just 170 years after its heyday".



Bruce Temple, a lifelong Nerriga local, sits in the very spot he occupied in the 1950s when he attended school in the building that now houses the Nerriga Old School House Museum.

"Less than 10 years after the Wool Road opened up, the lobbying power of businesses on the alternative, but longer, road to Sydney meant the wool was no longer taken down to Jervis Bay but instead hauled overland to Sydney," Josette explains.

"After becoming virtually obsolete, the road experienced a renaissance following the discovery of gold in the area in the 1850s and '60s."

PAINTING CREDIT PAGE 114, IAN HANSON, 1985, COURTESY JERVIS BAY MARITIME MUSEUM COLLECTION

Wool Road essentials



Route The Wool Road was built in 1841 to connect Nerriga to what is now Vincentia on Jervis Bay. Over time, several feeder roads from the Braidwood and Goulburn regions joined the original road. The route travelled in this article is the 126km drive from Tarago to Jervis Bay via Nerriga, which is also the shortest route from Canberra to the Shoalhaven Coast.



Distances from Tarago

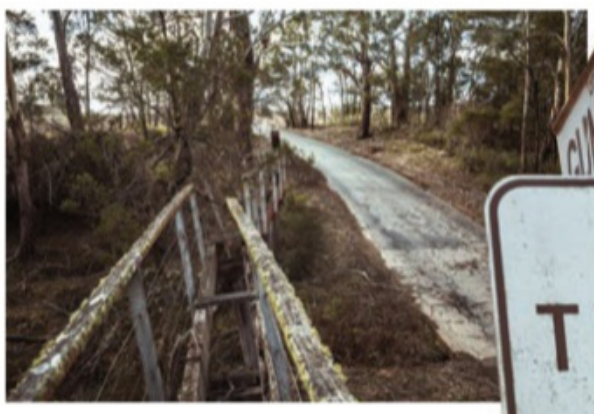
1 Nerriga Museum (57km): The go-to place for historical accounts of the old Wool Road; open second Saturday of the month.

2 Nerriga Hotel (58km): Perched on the edge of the wilds of Morton National Park, this bush pub is the modern-day hub of the Wool Road. The repurposed 165-year-old baltic pine that was once floorboards is now the main feature of a polished wooden bar.

3 Tianjara Falls (83km): Just metres from the roadside, this 60m drop can turn from barely a dribble to a cascading fury after a storm.

4 Jerrawangala Lookout (92km): From this lofty vantage spot on the Great Escarpment of eastern Australia, accessible down a short dirt track that's 2WD-accessible except after heavy rain, you can see a 100km stretch of the NSW coast, from Gerringong in the north to Ulladulla in the south. According to local lore Aboriginal people used this, as well as other vantage spots, to send messages to people hiking in the labyrinth of deeply channelled gorges and swamps that spread below. A number of ancient campsites have been recorded in the area along with a tool-making site and a scarred tree.

5 Jervis Bay Maritime Museum (125km): In response to renewed interest in the Wool Road, a new exhibit detailing the road's Aboriginal and European heritage is scheduled to open in 2020.



This Wool Road footbridge led to the old Nerriga school during floods.





Inside the Nerriga Hotel, a cosy local haven and popular traveller pit stop.



Josette Allester tends sheep on Tomboy, one of the last remaining properties to have continuously grown wool since the mid-1800s.

> "...these days you could fit the entire wool clip of this area on the back of a ute."

As for many regional museums, if you look beyond the glass cabinets crammed with paraphernalia of differing historical value, the real treasures here are the colourful stories regaled by locals.

Take, for example, 70-year-old Bruce Temple, a trustee of the museum and life-long Nerriga resident, who not only knows every twist and turn on the Wool Road like the back of his heavily calloused hands, but who also went to school in this very cottage.

You can even check out his grades, which, along with those of all the other students, are neatly recorded in carefully catalogued yearbooks under the blackboard.

Bruce explains that the numerous creek crossings around Nerriga weren't just a problem for those carting wool down to Jervis Bay, but also for the school kids.

"During one flood when the footbridge was washed away, some blokes at the sawmill [behind the school] had to piggy-back us back over the Bindi Brook creek," Bruce recalls, fondly. "We didn't leave school that night until eight o'clock, but at least we got home." Now retired, having operated a business carting wool for many years, Bruce is also able to shed some light on the mystery of the current lack of sheep in the district. "As recent as the 1970s, I'd take loads of wool into Goulburn, but these days you could fit the entire wool clip of this area on the back of a ute," he says. "Most of the farmers have moved into cattle due to lower long-term sheep prices."

IT'S SATURDAY, and up in town the Nerriga Hotel, which had dubious beginnings in the mid-1800s as a sly grog shop, is abuzz with lunchtime trade. Outside, a 44-gallon drum stocked with smouldering stumps is keeping motorcyclists, part of a passing rally, warm. Inside, thirsty tourists line the cosy bar.

"It used to be a bit like the wild west," says Bruce, who has tagged along, he says, "to make sure we don't get lost". He adds that "a publican in the 1960s encouraged patrons to shoot at targets across the bar with a pea rifle".

According to Bruce, during one especially heated argument, the publican "picked up his sawn-off .303 from under the counter" and shot a man through the stomach. "Although the poor fella survived, he lost part of his liver," Bruce deadpans. "They found the bullet lodged in the battery of a car parked out the front of the pub." Heck.





Since buying the Nerriga Hotel six years ago, Sarah and Phil Smith have given the old pub new life (above); the most intact section of the original Wool Road is near Nerriga (top right); part of the original Wool Road was blasted through Bulee Gap in the mid-1800s (below); Aunty Julie with a traditional possum-skin cloak with the Wool Road songline (bottom right).





Thankfully, these days there's no longer a need to duck under stray bullets when pulling up a bar stool in the historic watering hole, owned and run for the last six years by Phil and Sarah Smith, a couple of enterprising 30-somethings who live on site with their two young children.

"We almost dish out as many meals now as beers," Phil says. "One of the first changes we made was to add a family friendly beer garden out the back." And child friendly it most definitely is, complete with a giant blackboard for kids to doodle on.

While it's now the main pit stop on the Wool Road, especially for land-locked Canberrans making annual pilgrimages to the coast for some saltwater therapy, this bush pub is also a popular haunt for those eager to connect to their past.

"Soon after we took over the pub we noticed a bloke and his dad would come in about once a year and buy two schooners and a middy," Phil says.

"While drinking their beers on the front verandah they'd pour the middy on the ground.

"At first we thought the beer must have been bad," Phil says, laughing. "But it turns out the pop's ashes were scattered under the hotel so they come every year to have a beer with their pop."

An ancient pathway

The 1841 route of the old Wool Road primarily follows an ancient Aboriginal pathway from Nerriga to the coast.

Aunty Julie Freeman, a Gorawarl/Jerrawongarla woman who lives at the Wreck Bay Community near Jervis Bay, reveals, "For our people the road signifies a songline connecting the coastal people to the mountains, a pathway for trade, marriage and ceremony."

While there are significant Aboriginal sites along the road such as the Jerrawangala Lookout, according to Aunty Julie the really special places are down sidetracks. "Those side roads go to the real important places, secret places where a lot of ceremony was held," she says.

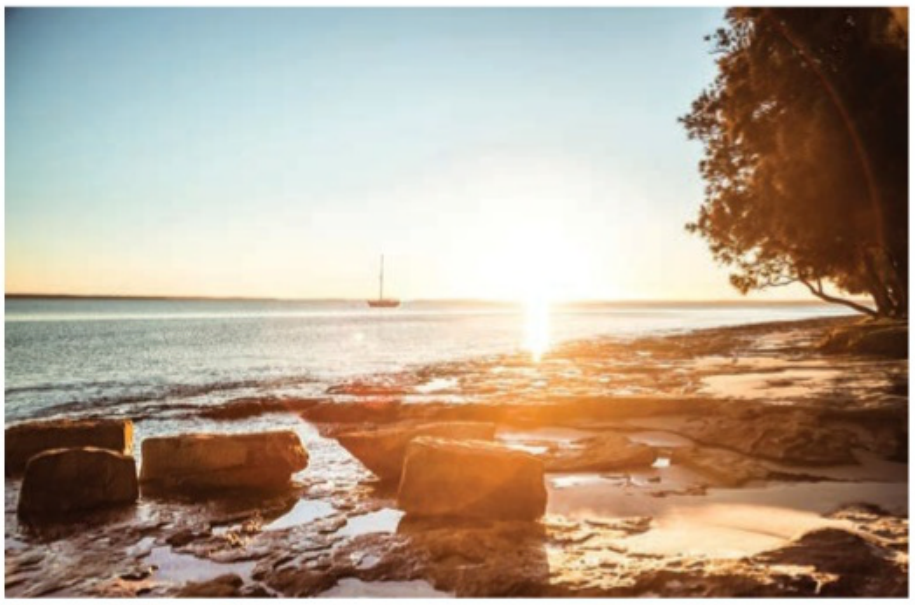
For her two children, Markeeta and Clive, the Wool Road is of added spiritual significance.

"Their father came from the mountains, so that pathway is part of who they are," explains Aunty Julie, who recently helped her children create a traditional possum-skin cloak featuring the Wool Road songline.

About five years ago a couple of teddies mysteriously appeared in a small cave on the Wool Road. Numbers have since grown and it's now a popular landmark for travellers.



These sandstone blocks are all that remains of the wharf at Vincentia, the official end of the Wool Road, where in the 1840s, wool was shipped to Sydney and beyond.





Roadside diversions

Although wool is no longer the dominant product grown along the Wool Road, the route features a number of farm gates including:

L'Air Du Wombat Truffles (41km): The altitude of the Southern Tablelands is ideal for growing truffles (above). In winter you can join Barry, a trained truffle dog, to hunt for black truffles. Or, year-round, enjoy an escape here in an off-grid bush cabin.

Sassafras Nut Farm (73km): Best known for tall timber, this locale is also home to a chestnut and walnut farm. Pick your own in season (autumn).

Nerriga Hall (59km): On the first Sunday of every month, local farmers peddle a variety of produce, including free-range pork, olive oil, garlic, wine and seasonal vegetables.

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WHILE THE DRIVE into Nerriga is dominated by undulating farmland, the landscape over the next 30km changes dramatically. Beyond Sassafras, one of several villages established to provide rest and relief for bullock teams passing through, tall trees give way to a rocky sandstone outcrop, complete with cliffs and pancake-stack rock formations known as the Bulee Gap.

Here, if you stop and explore the old route of the Wool Road, which sits below a series of modern bridges, and is at some points barely wide enough to spread your arms, you get a real sense of the 1840s engineering effort required to blast through this sandstone edifice. You'll also get a chance to admire the curious collection of teddies that have mysteriously proliferated in a roadside cave since the road was sealed in 2010.

Beyond the Bulee Gap the road traverses a narrow ridge – on one side is the dramatic gorge of the Ettrema wilderness, punctuated with rivers and waterfalls, while to the east a series of gnarly lookouts weathered from aeons of storms sit like giant knuckles guarding the coastal escarpment.

At one of these vantage points, Jerrawangala Lookout, the original Wool Road leads straight down the escarpment, and is best tackled in a four-wheel-drive, with spades of local knowledge.

For everyone else, it's an easy 27km stretch down to the Princes Highway, where at Sanctuary Point you can once again pick up the old Wool Road. (It's finally called that at this point.) A few kilometres further along, where Vincentia's Holden Street Boat Ramp runs into the glistening waters of Jervis Bay, is a handful of partly submerged hand-hewn sandstone blocks. Tacked on one is a small plaque that states these remnants are "all that is left of the wharf built in 1842 to ship wool to Sydney". It's the official terminus of the Wool Road.

After big storms, sand is often stripped away, exposing even more of the relic wharf, providing a tantalising reminder of our pioneering past. Although not as long as some of Australia's great drives, the Wool Road makes up in variety what it lacks in distance, especially if you are prepared to dig a little and venture off the beaten path.

Just don't expect to see many sheep.

AG THANKS Sue Robens and John Horobin for their country hospitality. **FOR MORE** of Thomas Wielecki's stunning Wool Road images go to *australiangeographic.com.au/issue152*


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For the Wild

Offer expires 31.10.2019 and is available to Australian residents only. To view Taronga Conservation Society Australia's privacy statement go to taronga.org.au/about/privacy

Photography by Lorinda Taylor

Expedition diary

AG SOCIETY HOSTED EXPERIENCES

Come on an adventure with us while raising funds for the AG Society at the same time.



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FROM 4–15 OCT 2019

Visit the world's oldest culture

BECOME IMMERSED in the ancient Indigenous cultures and prehistoric landscapes of Australia's remote northern coastline on a voyage of discovery that will take you off the beaten track in Arnhem Land, to the very tip of Australia at Cape York, and to the islands of the Torres Strait. Coral Expeditions offers a unique expedition opportunity to experience traditions unchanged for centuries, sacred rock art, and remote lands only accessible by a fortunate few. You'll enjoy being welcomed to isolated communities, educational experiences of nature and culture, encounters with wildlife, and onboard workshops. Choose from a range of voyages to this unique part of the world with small ship expedition experts Coral Expeditions.

WHO: Coral Expeditions
COST: From $10,695pp (twin share)
BOOKINGS: Call Coral Expeditions on 1800 079 545 or email *reservations@coralexpeditions.com*





Join AGS Managing Director, Jo Runciman, as your special host on the next Coral Expeditions small-ship expedition aboard *Coral Discoverer* to the home of the Saltwater People of Northern Australia on 4–15 October 2019.



THE VOYAGE An 11-night cruise along Australia's northern coast, from Darwin to Cairns.

ACTIVITIES Starting in Darwin and finishing in Cairns, this small-ship expedition immerses you in the timeless songlines and stories of Indigenous Australia. Travelling through Arnhem Land, the Torres Strait islands, Cape York and the Islands of the Great Barrier Reef, the trip focuses on the art and culture of the Saltwater People. Shore excursions will take you into remote communities and out into nature, while onboard workshops allow you to get hands-on with printmaking, carving and sketching. Expert guides and AG Society host Jo Runciman will enlighten and inspire you, while swimming, snorkelling and hiking will keep you active.

POINTS OF INTEREST
- Tiwi Islands cultural tour
- Ruins of Victoria Settlement at Port Essington
- Maningrida Arts and Culture Centre
- Elcho Island artists
- Sunset drinks at the northernmost tip of Cape York
- Guest lectures
- Art centre visits in the Torres Strait
- Forbes Island and reef
- Davie Reef
- Stanley Island rock art
- Lizard Island hike

MORE INFORMATION
Reservations: Call Coral Expeditions on 1800 079 545 or email *reservations@coralexpeditions.com*

Visit: *coralexpeditions.com*

Bookings: Call 1800 079 545 or email reservations@coralexpeditions.com



AG subscribers save 5%

DEC 2019

In the wake of Mawson

Follow in the footsteps of Sir Douglas Mawson and walk on the ice surrounded by penguins, seals, whales and gigantic icebergs with Heritage Expeditions. Travel on the complete expedition vessel *Akademik Shokalskiy*. This class of vessel is world-renowned for polar expeditioning because of its strength, manoeuvrability and small passenger numbers.

WHO: Heritage Expeditions
DATES: 15 December 2019 –8 January 2020
COST: From US$17,880
BOOKINGS: Email *info@heritage-expeditions.com*

BOOKINGS: *heritage-expeditions.com*

DATES: 1 & 10 August 2020

Explore the Kimberley coast with APT



Join APT and the AGS on a 10-day expedition cruise, exploring the Kimberley coast on an intimate small ship. Venture out daily on Zodiac excursions to remote locations usually inaccessible to most travellers and explore areas teeming with marine life. Be hosted by an experienced AGS host – Jo Runciman or Todd Tai. Enjoy an all-inclusive lifestyle on board, where everything is taken care of, and learn from your expert expedition team.

WHO: APT
COST: From $10,195*pp (twin share). Save $2000* per couple (already included in price shown)
*Terms and conditions apply

DATES: Departing 1 August and 10 August 2020. Week 2 available for return participants only
BOOKINGS: Call 1300 184 577

BOOKINGS: *aptouring.com.au/Kimberley2020*

DATES: 28–30 October 2019



Aussie Ark experience

Join Tim Faulkner for a unique hands-on experience with this Tasmanian devil and eastern quoll breeding program in the beautiful Barrington Tops of NSW. You will see devils up close as you help with feeding and monitoring individuals. There'll also be opportunities to explore the region's natural treasures and spot local wildlife at night. Don't miss your chance to get involved.

WHO: Aussie Ark
COST: From $1400 for adults

BOOKINGS: Call 02 4340 8610 or email *admin@devilark.org.au*

BOOKINGS: *devilark.org.au*



SHORTLISTED: THREATENED SPECIES

SPOT THE DIFFERENCE

Jess Hadden, Western Australia

ZEBRA SHARK, *STEGOSTOMA FASCIATUM*
WHALE SHARK, *RHINCODON TYPUS*

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VISIT

Government of South Australia
South Australian Museum
South Australian Museum, North Terrace, Adelaide
16 August - 10 November 2019

AUSTRALIAN MUSEUM
Museum of Applied Arts & Sciences
Powerhouse Museum Sydney
500 Harris Street, Ultimo
New South Wales 2007
16 August - 20 October 2019

Expedition diary

DATES: 12–24 November 2019



AUSTRALIAN GEOGRAPHIC READERS RECEIVE 10% OFF

Pioneers and frontiers of Papua New Guinea



Explore Australia's PNG connections on a 12-night expedition along the north-eastern coastline aboard the new *Coral Adventurer*. The voyage starts in Cairns with a charter flight* to Madang. We then sail north to the Sepik River mouth to enjoy the village lifestyle before heading along the coast, passing the active Manam Motu volcano and visiting WWII battle sites at Buna and Sanananda. Travel with AG Editor-in-chief Chrissie Goldrick as we explore the reefs and rainforest shorelines of Tufi Fjord and learn the myths of the Dei Dei hot springs. Local guides will show us villages where spirited welcomes, markets and singing performances will delight. **Additional cost*

WHO: Coral Expeditions
COST: From $11,290pp (twin share)

BOOKINGS: Call Coral Expeditions on 1800 079 545 or email *reservations@coralexpeditions.com*

BOOKINGS: *coralexpeditions.com*

DATES: 2–14 January 2020



AUSTRALIAN GEOGRAPHIC READERS RECEIVE 10% OFF

Raja Ampat and the Spice Islands odyssey

Scenic beauty, diverse wildlife and rich histories make this a journey of discovery and adventure like no other. Meet your AG Society host, Cornelia Schulze, in Darwin, board a charter flight* to Biak, West Papua, then board the new *Coral Adventurer* for a 12-night odyssey through the rarely visited Coral Triangle islands. Swim with Cenderawasih Bay's whale sharks, explore Fort Belgica and share tribal rituals and ceremonies. **Additional cost*

WHO: Coral Expeditions
COST: From $11,290pp (twin share)

BOOKINGS: Call Coral Expeditions on 1800 079 545 or email *reservations@coralexpeditions.com*

BOOKINGS: *coralexpeditions.com*



7–19 SEPT 2020

Ningaloo and the bluewater wonders

Join AG's Dr Dean Miller on a voyage to WA's remote and beautiful Coral Coast on board *Coral Discoverer*. Departing from Broome, it will visit the spectacular Rowley Shoals Marine Park, Dampier Archipelago and historic Montebello Islands and culminate in a visit to Ningaloo Reef, home to gentle giant whale sharks and manta rays.

COST: From $11,590pp (twin share)
BOOKINGS: Call Coral Expeditions on 1800 079 545 or email *reservations@coralexpeditions.com*



7 NOV 2020

Circumnavigate Australia

To mark Coral Expeditions' 35th anniversary, Australia's pioneering cruise line has announced a circumnavigation of the Australian coastline in 2020 aboard the new flagship *Coral Adventurer*. Visiting 35 places that shaped Australia, the trip's unique VIP events will make it a voyage to remember. The 59-night voyage begins and ends in Darwin.

DATES: 7 November 2020–5 January 2021
COST: From $38,860pp
BOOKINGS: Call 1800 079 545 or email *reservations@coralexpeditions.com*

AG SOCIETY PHOTOGRAPHY TOURS

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SAVE

MAY & NOV 2020

Photography Weeks on Lord Howe Island

pinetrees.com.au

LORD HOWE ISLAND is one of Australia's best photography destinations. It's World Heritage listed because of its scenic beauty, biodiversity and rare flora and fauna and offers a large variety of terrain in a small area. Walking and Photography Weeks combine the skills of local guides and photographers to help you discover and capture the island's stunning landscapes and life forms. Most walks have expert guides to explain the plants, geology, birds and marine life. Amazing photos are guaranteed.

DATES: 11–15 May 2020; 9–13 November 2020
COST: From $3048pp (twin share) at Pinetrees Lodge
BOOKINGS: Call Pinetrees Travel on 02 92626585, email *info@pinetrees.com.au*



Fly Free*

FEB 2020

Classic Antarctica

UNIQUE WILDLIFE, thrilling Zodiac rides, unparalleled glacial scenery – welcome to Antarctica! Experience it all on this spectacular 15-day journey, which includes a four-night stay in Buenos Aires. Each day brings new levels of excitement and anticipation as you cruise the Drake Passage, a remote land of ice and wonder. Wake up to a world of white floating on a deep-blue sea and, as the magnificent scenery beckons, head out with your Expedition Team to explore glaciers and frigid waters strewn with icebergs of all shapes and sizes. Come face to face with pods of curious whales that breach only metres from you, then land on an isolated cove to walk among a noisy penguin colony.

WHO: APT
DATES: Departs 13 & 15 February 2020
COST: From $21,195*pp (twin share) Based on Deck 6 stateroom. Deal: Fly Free* (T&C's apply)
BOOKINGS: Call 1300 278 278

aptouring.com.au/isaa15r



JUNE & JULY 2020

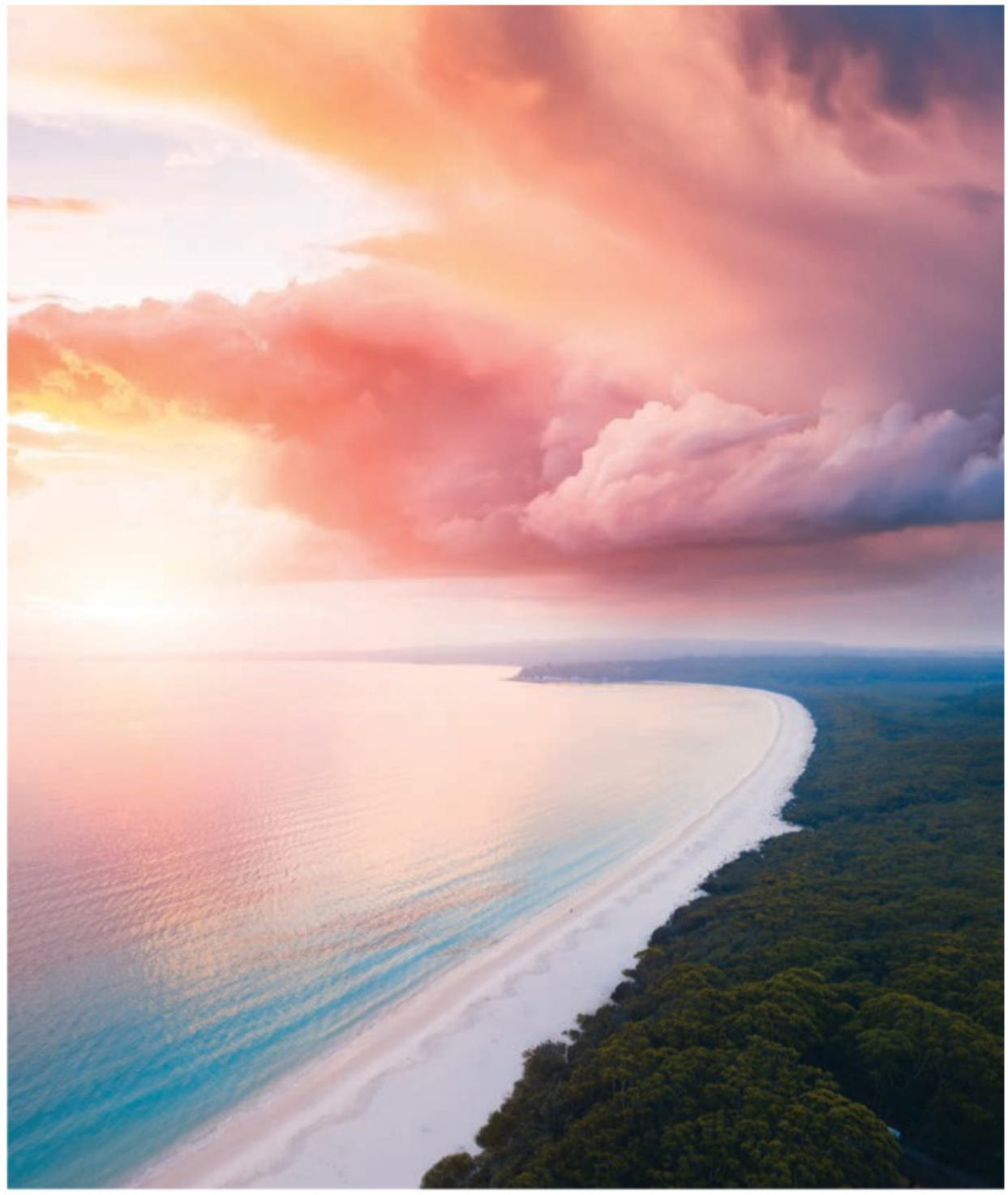
SAVE $2000*

Arnhem Land Expedition Cruise with APT

EXPLORE ARNHEM LAND'S remote coastline and the pristine Tiwi Islands on an eight-day small ship expedition cruise aboard MS *Island Sky*. Land on the Gove Peninsula and experience a Welcome to Country ceremony on South Goulburn Island. Get a bird's-eye perspective of Arafura Swamp on an included scenic flight, and see 60,000-year-old art styles take shape before your very eyes. Enjoy an all-inclusive lifestyle on board where everything is taken care of for you.

WHO: APT
DATES: Departs 29 June and 25 July 2020
COST: From $9395*pp (twin share), save $2000* per couple (already included in price shown). *T&Cs apply
BOOKINGS: Call 1300 184 577 or visit

aptouring.com.au/ArnhemLand

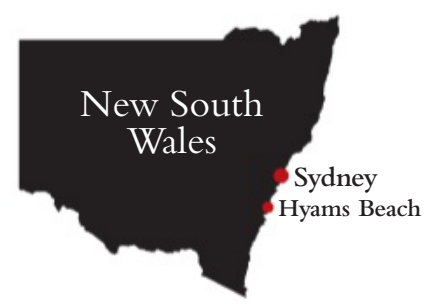


EYE IN THE SKY

Hyams Beach, Jervis Bay

By Tom Noske

THE CLAIM several years ago that Hyams has the "whitest" sand of any Aussie beach sparked a minor controversy. It led to a Murdoch University study that ultimately disproved the claim. While Hyams' sand *is* very white – and famous for it – scientifically speaking the "whitest" is at Lucky Bay in Western Australia. But sand colour is just one stunning feature of Hyams. It lies on the southern shores and crystal-clear waters of Jervis Bay Marine Park, in the Shoalhaven. For yet another reason to visit this pretty region see *The old Wool Road* on page 114.

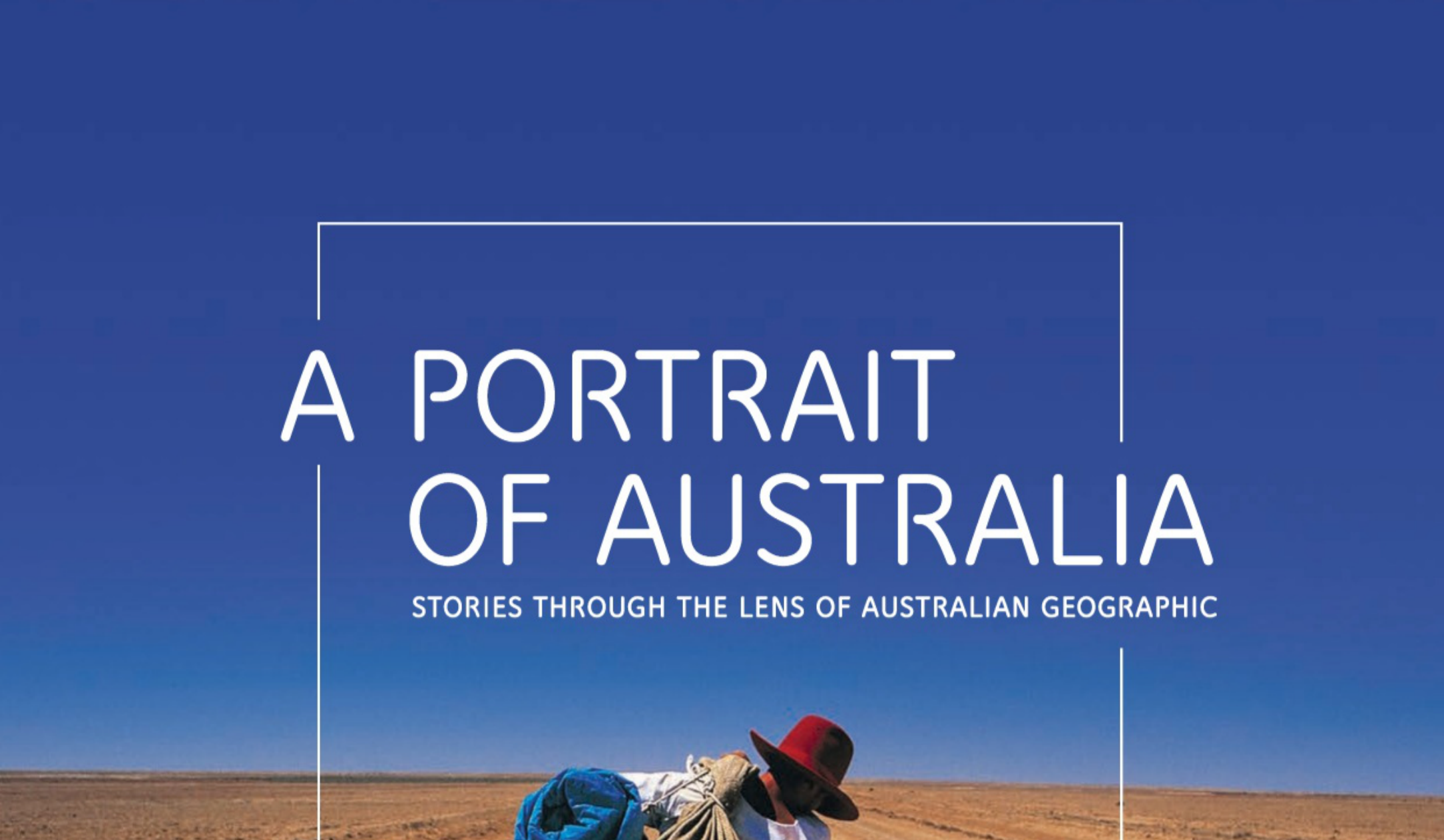


DJI mavic 2 pr | ISO 100 | 10.26mm | f/5.6 | 1/20 sec

Drones. Love 'em or hate 'em, there's no doubt they are changing the way we do and see many things. You may baulk at the sight of a drone flying around in the great outdoors, but this technology is providing us with amazing new perspectives on familiar landscapes.

A PORTRAIT OF AUSTRALIA

STORIES THROUGH THE LENS OF AUSTRALIAN GEOGRAPHIC

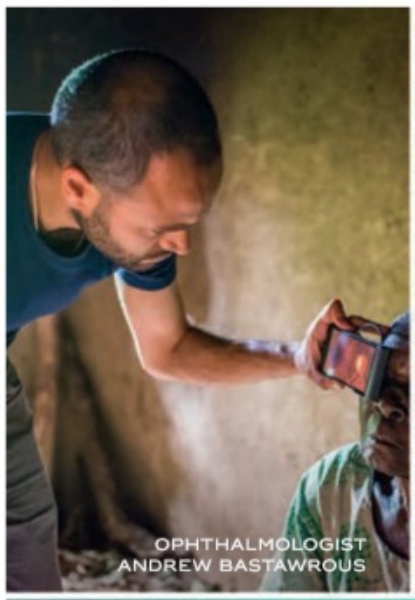


Discover the remarkable stories of ordinary Australians in this exhibition celebrating the bush, the outback, the coast and the people who live there.

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COBB+CO MUSEUM
9 August – 27 September 2019
27 Lindsay Street, Toowoomba, Queensland, 4350 | cobbandco.qm.qld.gov.au

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A travelling exhibition from the National Museum of Australia developed in collaboration with Australian Geographic. Photograph by Colin Beard.















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